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Engineering News-Record

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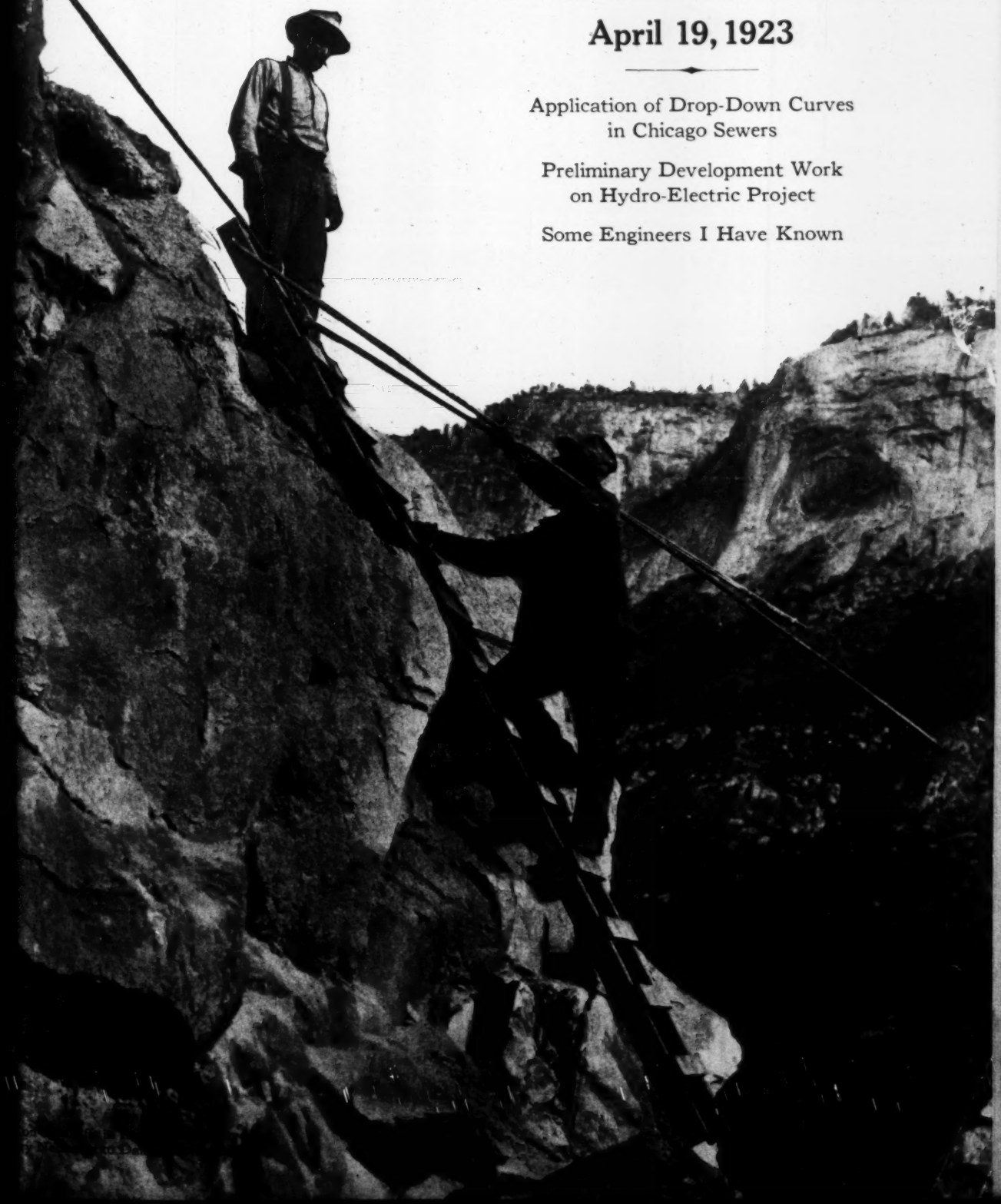
April 19, 1923

Application of Drop-Down Curves in Chicago Sewers

Preliminary Development Work on Hydro-Electric Project

Some Engineers I Have Known



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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN, *Editor*
FRANK C. WIGHT, *Managing Editor*

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A Regrettable Failure

DEEP as was the regret awakened by the first news of the disastrous tower collapse at Hartford, it was accompanied for the structural engineer by a sense of alarm resulting from the disturbing uncertainty concerning the causes of the failure. The latest reports set at rest such feelings of uncertainty, by revealing a most elementary cause—though in doing so they only sharpen the regret and sorrow at the deplorable loss of lives in the accident. Little doubt appears to be left by the investigations of the tower ruins that the most simple and best known of structural causes, lack of bracing, led to the collapse. Insufficient bracing has been known and feared since the earliest days of construction, and no engineer needs to learn from the Hartford case the lesson of keeping his structures well braced. But he may learn, and should mark it down imperishably in his conscience, that unceasing watchfulness over every detail of work is necessary if he is to carry out his responsibilities to the world. A single thoughtless or faulty decision may bring destruction. Physician or lawyer may err much more grievously and yet go their way in peace and esteem; the errors of the engineer rise up against him.

Making a Name Bad

IT HAS been amusing and rather flattering to the serious professional man to observe how extensively men in non-professional pursuits style themselves "engineer." To take a harmless instance: on our desk lies a letter written under the engraved caption of an "Advertising Engineer," which proud title means nothing more or less than "engineering advertising agent." But from being mildly amusing, as is interestingly sketched by a correspondent on page 604 of this issue, the matter is taking on or has already taken on a less pleasant aspect: to an ever-increasing extent the word "engineer" is tending to become a nondescript appendage carrying objectionable implications of fake and pretension—almost fraud. The engineering profession takes pride in the title of its calling, and inevitably resents all mischievous and misleading assumption of its class name. While it has up to now taken a tolerant, smiling attitude toward the abuse we suspect that the attitude is rapidly changing to one of active hostility. The fact remains that the title is the necessary designation of a large class of men engaged in responsible, difficult, professional work, and they can not long countenance its flagrant misuse, whether within or without the profession. For wrong or unworthy use within the profession remedies of law are available. Abuse on the part of non-professional men must be fought by engineers themselves, through group opposition. It will be only logical defence of its vital interests if the profession sets up the ethical principle that its members should conduct no business with pseudo-engineers.

State Road Funds

LAWS enacted this past winter leave only three states totally dependent on their county governments for funds for highway improvement. These three incorrigibles are Kansas, North Dakota and South Dakota, the first two being also rather notorious for their reactionary attitude generally toward centralized highway administration. As the division now stands, 23 states finance highways entirely through state funds and in 22 states the state fund is aided by direct contributions by counties or land benefit districts. Federal-aid legislation has to be credited in large measure for the improved conditions.

Construction Inflation

INFLATION of construction is a hazard that deserves very serious consideration at the present moment. At a conference last week in New York City of engineers, contractors and materials producers to consider ways and means for improving the construction situation it was agreed that this year, according to the best judgment of volumes, the country is attempting a program of some 200 per cent of normal at a cost approximating 150 per cent of what should be the normal. A condition of inflation will be the inevitable result, if this demand for immediate construction continues, and depression invariably follows inflation. There is a vast arrearage of construction to be met, but to attempt to do it too rapidly involves risk. It is doubtful if our productive resources will permit any such rate as twice the normal volume. Certainly, there will be, indeed there already is, an inflation of wages and prices. It seems by far the wiser course to spread the covering of arrears over a term of years. The conference in New York concluded that an annual program of 125 per cent of the normal was about correct. Whether or not it is exactly correct it indicates the only sane line of procedure with the conditions of the construction market as they are. The duty of initiative rests squarely upon the public which buys construction. The buyer must curtail his demands or he and the public with him will pay a cruel price in inflated costs.

British Refuse Disposal Changes

THE British high-temperature refuse disposal never handled so large a percentage of the refuse of British cities as it has been credited with by some. During and since the war, labor and other conditions have made this percentage still less. Coincidentally there has been a marked gain in (1) refuse sorting for the recovery of salable materials like paper, cloth, glass, leather and metal; (2) in screening for the recovery of unburned and partly burned coal; (3) pulverizing or shredding of the garbage and like wastes; and (4) the use of the disintegrated material and the sifted ashes for fertilizing and lightening the soil. Destructors are still kept in use at old plants and installed at plants of

the newer type, but the bulk of material put through them is greatly reduced by the sorting and screening mentioned and what is sent to the destructor has a higher heat value than of old because it is not accompanied by a large mass of inert ash. There is also a material reduction in the work of stoking and in the volume of material that passes from the furnace for final disposal. Some of these points and others as well are illustrated by the practice at Newark, England, described elsewhere in this issue. The plant mentioned is only one of many that show a marked change in the trend of British refuse disposal methods. This change will bear watching here but too hasty conclusions should not be drawn from it in view of a variety of differences between British and American conditions.

Record Runs of Equipment

IN APPRAISING the value of equipment for construction work the best criterion is day-in-and-day-out performance, rather than the occasional and sensational record run covering only a short interval of time. This is the consensus of equipment manufacturers who have been expressing opinion on this subject for several weeks past in this journal's weekly department "From the Manufacturer's Point of View." From what has been said it is clear that the practice of featuring record runs works to the disadvantage both of the user and the maker of machinery. As a general rule, record performances are achieved under particularly favorable conditions but statements of the results attained are usually unaccompanied by any explanation of the conditions contributing to such performances. In the hands of an inexperienced contractor such records are extremely dangerous, for he may be led to base an estimate of the season's work upon the rate maintained during the record run. Many men have paid dearly for such optimism.

In the case of a machine like a concrete mixer on a highway contract, for example, many factors outside of the machine itself play a part. The mixer can attain its maximum output only if the supply of crushed stone, sand and cement is regular and ample, and this brings into the problem the operation of the motor truck train, the industrial railway and also the standard-gage railway. With the same mixer, therefore, the yardage on one day may be double that on another due to good or bad co-ordination of material supplies. The same condition arises in the case of a steam shovel. Obviously its output depends not merely on its own digging capacity, but upon the provision of an adequate supply of empty cars or trucks to take away the material excavated. Record performances covering only a brief interval of time, therefore, mean little, even when the full story is told. This is particularly true in the case of equipment or machinery which depends for its operation to a large extent upon the human element.

A slightly different case is that of a machine whose operation is largely automatic—for example, a stationary, electrically-driven pump. Here the conditions are much more constant than on an outside construction job and performance day by day can be measured and judged with a considerable degree of accuracy. In either case, however, it is the continued performance which really counts and which forms the only measure of serviceability upon which the user can rely.

Then, too, from the manufacturer's point of view, the featuring of a short-time record run has often proved a boomerang. Users of precisely the same equipment on other jobs immediately want to know why their machines are not performing up to the standard set by the record performance. It would, of course, be folly to attempt to kill pride in good performance. Credit should go where it is due. The point here made, however, is that continuity and regularity of service of contractors' equipment are far more useful as an index of performance than the sensational record which often proves to be merely a flash in the pan.

Economics of Highway Design

TWO opinions are held by engineers on the desirability of economic refinements in locating and designing public roads. One is exemplified by the article in this issue by O. L. Kipp; it is that an appreciable and an appreciated reduction in traffic costs follows and justifies careful determination of the economic location, alignment, length, grade, width, and surface of a highway. The opposing opinion, somewhat more intolerant, is that the average road user is too little concerned in vehicle-mile costs to justify expenditure to secure the last fraction of saving and that any other viewpoint is purely academic. An interesting question is involved.

The last opinion, perhaps the more common, is based on the conception of traffic as travel for recreation and business not involving the carriage of freight. Car-mile or ton-mile costs, with travelers of this class, are of secondary concern. Also this class of highway travel predominates; even in states of such heavy truck traffic as Massachusetts and Connecticut vehicle counts show from three to five times as many automobiles as freight carrying trucks. This excess of vehicles not operated specifically for profit from commodity carriage is certain to continue. So long as it continues there is sound reason to proceed slowly in adding to construction costs to reduce costs of vehicle operation to the ultimate minimum. Economics and public policy are both involved in this conclusion.

Taking the country over the thing that traffic today demands most is the greatest practicable mileage of public roads which can be traveled during the largest possible portion of the year. Until highway development has progressed well toward this attainment, other means of cutting down the costs of highway travel are in general secondary in importance. Whether or not the closet economist agrees with this statement it expresses exactly the attitude in the situation of the average road user. He wants more miles of well-built road rather than fewer miles of road perfected to reduce to a minimum the expense of vehicle operation. It is the primary function of the highway engineer to satisfy this want, whether or not it stands out in contradiction to economic principles. This is a fundamental of which sight cannot be lost or highway engineers will have to count with the reaction of the people against engineering direction of road policies.

It cannot be overlooked that in a chiefly non-income earning traffic there is little argument for extra expenditure in construction to reduce traffic costs. A different aspect of the problem is presented if the primary purpose of the highway is considered to be the carriage of freight for a profit. Then users exist in predominating numbers who count car-mile and ton-mile costs vital to their business and who also count extra cost of construction justified in any amount less than the capitalized value of the reduction in haulage

costs which it effects. Here then is the second conception of highway traffic development—one which largely justifies the economics of location and design considered in Mr. Kipp's article.

Not including minor township roads, for which the answer is clear, the question is not whether all roads or whether any roads should be located and designed primarily to reduce traffic costs but it is: What roads warrant this undertaking? A certain few roads which do warrant it, because the traffic is in evidence, can be picked out in every state, but traffic surveys of wider scope than most states have conducted are necessary for any close traffic classification of main roads in a state-wide way. This assertion is proved by the returns, so far received, of the Connecticut traffic survey. In this state, where distances are short and all areas are highly developed and improved roads date back a generation, the survey shows clearly that general observation is a very poor indicator of either the character or the amount of travel. Obviously it is less perfect in the greater areas of the western and southern states.

There is nothing in the conditions indicated that should be taken as discouraging economic studies of highway design. Held in the least consideration they are formulating the problem and indicating where research is necessary in order to proceed with a solution. The article by Mr. Kipp is particularly useful in bringing out the need of determined facts. It is cheering to announce that research is gradually producing them.

For a Renaissance of Craftsmanship

OF FAR-REACHING importance is the work now being carried on by the Apprenticeship Commission of the New York Building Congress and by similar bodies in Boston, Philadelphia, Detroit, Cleveland and other large cities the country over. These commissions represent a joint effort on the part of the employers and the employees of the building industry to provide a continuing supply of competent mechanics through a systematic field and classroom training of apprentices, conducted under the supervision of both the employers and the building trades unions. A brief account of the procedure that has been followed in New York was published in *Engineering News-Record* of Jan. 11, 1923, since which time the operation of the plan has gone far to confirm the faith of all parties in the soundness of their joint undertaking.

The importance of this enterprise lies not alone in the bare fact that it provides for the training of a certain number of young men to become competent building craftsmen. It offers promise of other results that will be of even more fundamental and far-reaching significance. One of these, perhaps, is the co-operation that has already been realized between the building trades employers and the trades unions, both of whom have shown genuine industrial statesmanship in their handling of the many vexing problems that have arisen. This task, to which they have so successfully applied themselves, is a constructive work; and the more often we can draw together the representatives of organized labor and of the employers to conduct such an enterprise rather than to wrangle over their differences, the sooner shall we find growing in each of them that confidence in the other which alone can bring about complete understanding and co-operation.

Another worth-while result will be the preservation and transmission to a new generation of mechanics of the unwritten teachings that were current among the skilled of many crafts a generation ago, but which today are the heritage of a diminishing few. The soul of a craft resides in such teachings and traditions, and without a knowledge of them the craftsman is little more than a skilled laborer. By fostering these, the present enterprise may well contribute to a renaissance of craftsmanship at a time when many have almost been ready to give up hope.

But of even greater importance is the opportunity here offered to regain for the competent craftsman a measure of the standing and general esteem that in another day was at once his unquestioned right and his greatest pride. Of recent years the American born and educated boy has been reluctant to enlist in the ranks of the craftsmen. Too often he has succumbed to the lure of the white-collar job, bent upon the superior (?) social standing that he has associated with the office worker. Frequently, indeed, he has been willing to make this choice at an actual sacrifice in financial return, all for the sake of the intangibles he has believed to be involved.

Lately, however, this idea has been severely jolted and complacency has begun to waver. The mechanic has prospered while the lot of the white-collar worker has become less and less enviable. Today the young man is wondering, and in many cases it will take a slighter push than has been required heretofore for him to reach a decision favorable to the craft as against the clerical job. And we are inclined to think that that slight push may be developed by the work of the apprenticeship commissions, provided only that their members are alive to the human factors bound up with their enterprise.

The young men who complete successfully the prescribed courses in the classroom and the field should be imbued with the dignity of their calling, and the community in general should be taught to appreciate the essential worth of a competent craftsman. The commissions, in other words, must labor not only to *produce* craftsmen but also to *sell* them. And they must be sold both to themselves and to the public-at-large. Within the young journeyman must be instilled that pride of craft which alone can lead to the highest efficiency and achievement, and in the community must be instilled a new respect for the American mechanic. Through such a process only can we break down the artificial and unhealthy prejudice in favor of the white-collar job—all too often a non-productive job, of which industry already is saddled with an overplus.

Given a supply of competent building mechanics having an honest pride in their crafts and in their craftsmanship; and given a general public imbued with the old-fashioned American respect for the competent craftsman, we need fear no dearth of skilled mechanics that will be a credit to themselves, to their trades, to their employers and to the community. Today the problem is not essentially one of wages; it hinges in large measure on the human element and will yield to treatment that holds that element in the forefront of consideration. Just such a treatment the apprenticeship commissions have it within their power to apply; and in this aspect of their work they will find the fullest measure of ultimate satisfaction and achievement in the work they are carrying forward so worthily.

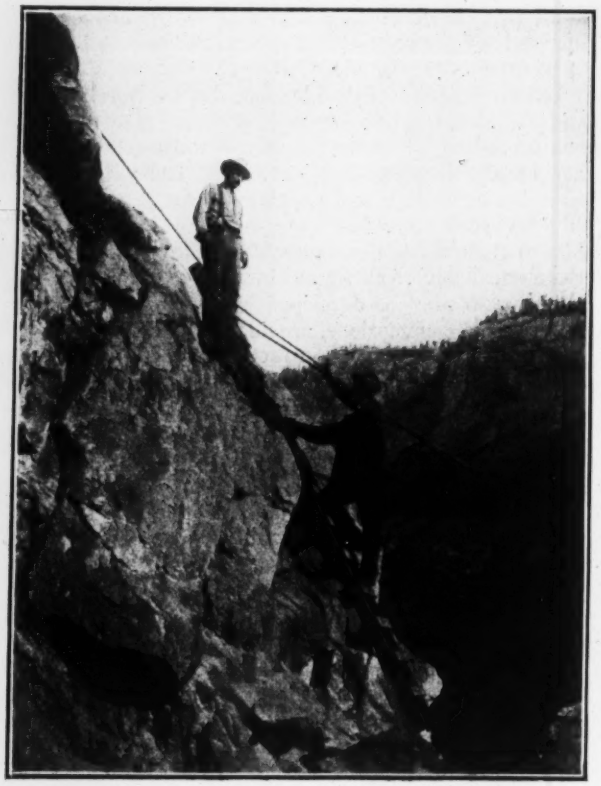
Preliminary Developments On a Hydro-Electric Project

A 300,000-Hp. System on Kings River in California Begun With the Building of Camps, Roads, Bridges and Gauging Stations—Winter Quarters Maintained by Hydrographers

By H. K. Fox
San Joaquin Light & Power Corporation, Fresno, Calif.

ON THE north and west forks of the Kings River in California, the San Joaquin Light & Power Corporation has started work on the first unit in a chain of hydro-electric developments that will ultimately produce more than 300,000 hp. The main features of the development will be four storage reservoirs, ten diversion dams, 34 miles of tunnel and conduits, and seven power plants.

At the present rate of increase in power demand it may be necessary to develop the entire series of plants by 1930; however, in applying for the Federal Power Commission license, which was granted last year, the main construction program was divided into five parts,



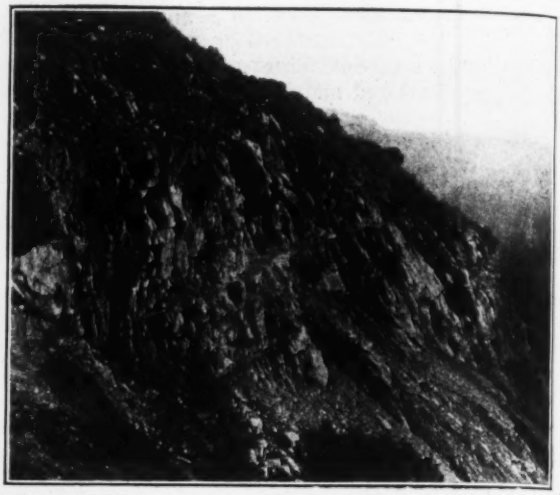
ROAD WORK ON THE CLIFFS IN KINGS RIVER CANYON
The ladder suspended by a rope is 300 ft. above the bottom of the canyon. Drilling is in progress on the face of the cliff below.

each including diversion dam, tunnel, penstocks, power house, etc., and with the construction program estimated as follows:

Development	Work To Start	Work Finished
Balch No. 1	May, 1922	June, 1925
Haas Plant	April, 1924	June, 1927
Kings River Plant	January, 1926	June, 1928
Balch No. 2	April, 1926	June, 1929
Farnham and Meyer Plants	April, 1927	June, 1930

The remainder of the program which would be largely the development of more storage and additional power capacity will be made as power demands require.

Preliminary surveys and studies have been under way for some time and as early as 1919 about 100 engineers and surveyors were working through the area involved. In that year a very precise triangulation system was established to which all lines and topography

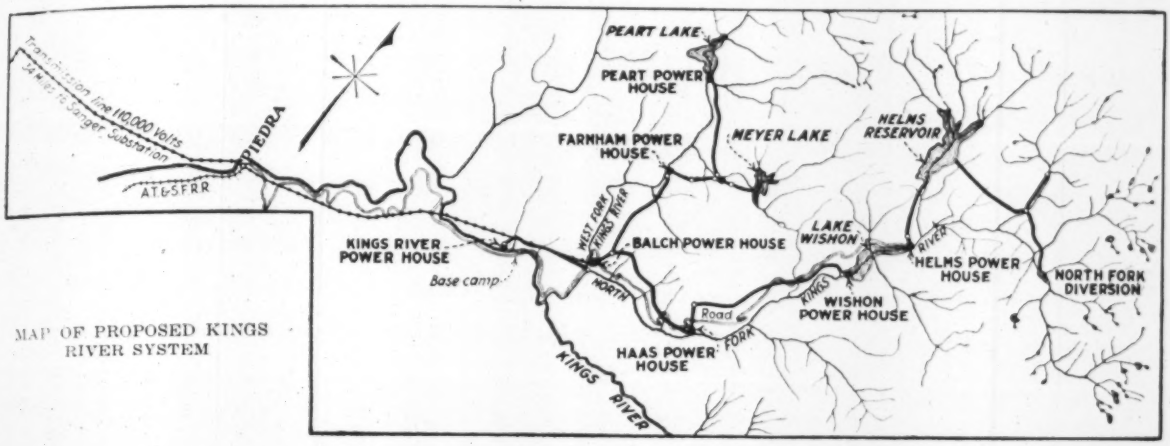


ROAD UNDER CONSTRUCTION BETWEEN BALCH AND HAAS PLANTS
In two places trestles were cheaper than bench cuts. At one point a cut 100 ft. deep was made to provide a bench for the road 12 ft. wide.

could be tied; old trails were rebuilt and new ones constructed and eight tent camps were being maintained throughout the project.

While the surveys were being made stream gauging was started and six stations, built according to U. S. Geological Survey standards, are now in operation. Four hydrographers are kept the year round at elevations of over 8,000 ft. in the "snow country" for making continuous record of rain, snow and runoff conditions. In summer they are busy packing in supplies, getting up wood for the winter, and repairing the stations. During the winters, which come early and stay late at these altitudes, these men are isolated from the rest of the world for periods of two months without means of communication.

Actual construction thus far has been, and the major portion for some little time to come will be, in building roads and camps. Piedra, on the Santa Fe R.R., is the nearest point of rail delivery and all materials and supplies for the project must be hauled in by trucks or teams. The route is over a county road for the first 13 miles to Trimmer at which place the company built a bridge across the main Kings River. Beyond this crossing, 12 miles of road to the base camp was built many years ago by the original holders of the project. This was reconstructed by the company in 1921 and is now used by motor trucks. From this base camp freight has been delivered into the upper country by pack trains. A bridge across the main river at the base camp was built in 1921 with two 100-ft. span wood trusses designed for a 30-ton load. From this bridge



MAP OF PROPOSED KINGS RIVER SYSTEM

to Balch camp, a distance of 3½ miles, a narrow road was built. Work on the project was then discontinued until August, 1922.

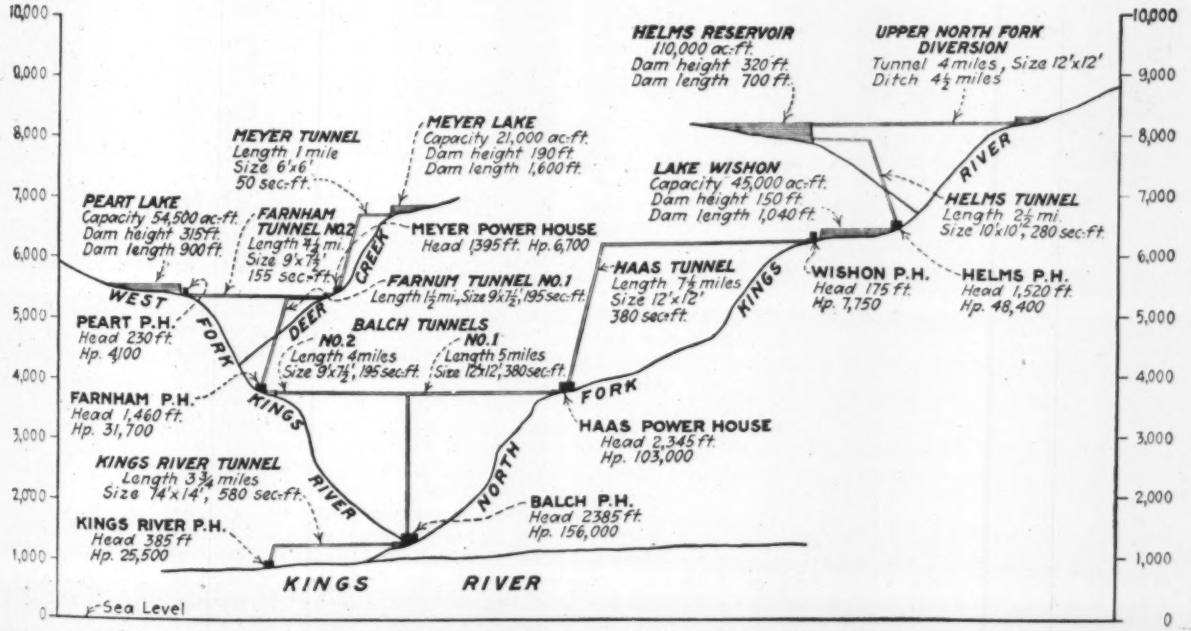
In resuming development last fall the first step was to build a bridge across the north fork in order to reach headquarters camp, known as Balch camp. Here a modern construction camp that can accommodate up to 300 men has been built and equipped with water and sewer systems, bath houses, public library, electric cooking equipment, etc. A good road has also been extended to points in the upper country.

From Balch camp the road rises on a uniform 6 per cent compensated grade; it is 12 ft. wide in cuts and 14 ft. on fills. In order to gain the necessary elevation it was located 1½ miles up the west fork and then brought back above the camp and up the north fork. The country is very rough and careful location was necessary in order to maintain a uniform grade without getting into costly work in the cliffs. At one point, however, crossing the face of a cliff could not be avoided, and here it is necessary to make a side cut 100 ft. deep in order to get a 12-ft. bench for the road. In two places along these cliffs it was decidedly cheaper to build trestles than to excavate the yardage necessary for making a bench cut.

Work on the road beyond Balch camp was started by station gangs and later day labor was used for the more difficult parts. Much of the material excavated is solid rock and loose boulders, but even in this ground good progress has been made.

Tent camps are located about every two miles on the line and supplied where necessary by pack trains. A temporary 18-in. gauge incline railway was built from Balch camp to a camp on the road line directly above, which made it possible to work almost the entire first three miles without using supply pack trains, and also made it possible to deliver gasoline driven air compressors so that work could be started on the 4,000-ft. section across the face of cliffs already referred to.

The road to this heavy cliff cut has now been completed and the incline abandoned. Work in the cliff will soon be finished and beyond that point a ¾-yard



SCHEMATIC ELEVATION OF PROPOSED KINGS RIVER SYSTEM

TYPICAL WINTER QUARTERS FOR THE HYDROGRAPHERS

steam shovel mounted on caterpillars will be used. This shovel is at present widening the road from Base camp to Balch camp. The slopes are so steep and rocky that teams and fresnos have been used only to a limited extent.

The work is being done under the direction of R. C. Starr with the writer as superintendent of construction, R. L. Bryant as resident engineer and J. D. McDougald as general foreman.

Determining Sub-Surface Water Flow Electrically and Chemically

BOTH chemistry and electricity were utilized in testing the underground flow of water at South Bend, Ind. In a paper on "Development of Well Water Supplies" at the recent meeting of the Indiana Water Supply and Sanitary Association, John W. Toyne described the procedure as follows:

A central 12-in. well surrounded by 2½-in. wells at a radius of 6 ft. were sunk to a depth of 155 ft. into gravel formation having the following characteristics:

30 per cent by volume retained on a No. 10 screen
25 per cent by volume retained on a No. 20 screen
40 per cent by volume retained on a No. 40 screen
17 per cent by volume retained on a No. 60 screen
7½ per cent by volume retained on a No. 80 screen
2½ per cent by volume retained on a No. 100 screen
1 per cent by volume retained on a No. 110 screen

After the wells were equipped with strainers to suit this formation, the central well was charged with 200 lb. of salt and basic fuchsin, and the surrounding wells were equipped with electro couples connected with the 110-volt lighting circuit through a sensitive ammeter. Current readings were taken hourly and to insure true sampling of the vein, 1 gal. of water was pumped from each well at the time of taking the readings. It was examined by comparison with the original samples for traces of color.

The time required for the flow of 5 ft. was 82 hours as evidenced by the drop in electrical resistance and positive traces of color. The direction of flow was found to be just north of true northwest.

While the result of this test is not conclusive, it is confirmation of my belief that the water supply enjoyed by the city of South Bend, is in no sense local in character, but a part of the general underground movement of water across northern Indiana toward Lake Michigan. This theory is further corroborated by the logs of some 200 wells in northern Indiana and northern Ohio with which I have come in contact in the past fifteen years.

The result of this test thoroughly justifies the development of the additional supply as economically sound and permanent. As to the safety of the supply from a sanitary standpoint, the surface flow is toward the St. Joseph river, or at almost exactly right angles to the lower flow and at sufficient velocity to indicate that a part at least, is supplied from the lower vein. The surface flow would have a tendency to maintain the purity of the supply to the wells by washing the surface contamination off into the river; in any event strata are covered by a deep slow-sand filter.

Treatment of Water Contaminated by Mine Drainage

BY J. W. LEDOUX
Consulting Engineer, Philadelphia, Pa.

Abstract of a paper read before the Pennsylvania Water Works Association

THE problem of providing public water supplies in that portion of Pennsylvania which is underlain with coal is becoming more difficult as mining development increases. According to the published statistics of coal deposits, the bituminous coal of Pennsylvania of productive commercial value covers an area of 14,200 sq.mi., but the area within the outcrops covers about 16,600 sq.mi. This area lies on the western slope of the Allegheny Mountains and comprises a solid block of coal territory, within which there are only about 600 sq.mi. in various patches that are above the possibility of coal mine drainage. The total population of this coal area is considerably over 3,000,000 inhabitants.

The coal seams all contain sulphur and iron, and the rock formations immediately in contact with the coal contain iron pyrites, or sulphide of iron. When these coal beds are left untouched, the streams draining the coal lands are usually not contaminated to any marked extent by sulphur water. As soon as they are broken by mining, the water flowing from the mines dissolves the sulphur and iron, becomes highly charged with sulphuric acid, and, if undiluted, will attack metals. Where the mine opening is below the ground-water level the water must be pumped out by means of wood-lined pumps through wood or cement-lined pipes. When the water reaches the small streams it colors them black or yellow, kills fish and vegetation, and if in material quantity makes the stream unfit for use as a water supply.

Five Methods of Treatment Summarized—Much study has been given to the problem of neutralizing mine water and making it fit for industrial use. Many experienced engineers and chemists have endeavored to solve the problem. The difficulty is so great that the usual outcome has been the adoption of a new and uncontaminated supply. [After reviewing various attempts to treat waters rendered acid by mine drainage and discussing certain possible methods, Mr. Ledoux concluded with the following summary of costs of five methods.—EDITOR.]

1. By far the cheapest process is neutralization by lime and the softening by soda ash, but this would leave so much sodium sulphate in the water that it would be impracticable.

2. Next in order of cost would be neutralization by lime, removal of two-thirds of the sulphate by heating the water to 356 deg. F., using heaters and boilers, and treating the remaining water with soda. The final water would contain about 270 p.p.m. of sodium sulphate. The cost would be about 15c. per thousand gallons.

3. Neutralization by lime and purification by means of multiple effect evaporators. The cost per thousand gallons would be about 32c., and this water would be free from all objectionable qualities.

4. Barium hydrate treatment. The resulting water would be free from all objections, but the cost would be 45c. per thousand gallons.

5. First removing two-thirds of the calcium sulphate by heat; then treating the water with barium hydrate. The resulting water would be free from all objections, but the cost would be approximately 28c. per thousand gallons.

The heat method has the advantage that its cost does not depend on the quantity of sulphates in the water, but by the chemical method the cost of chemicals, which is by far the largest item of expense, is directly proportional to the sulphates in the water. Therefore in the present state of the art it is the writer's judgment that there is no simple and economical method of purifying mine water to a sufficient extent to make it suitable for general use.

The writer believes that the method which offers the most promise is barium hydrate for the reason that the precipitate, barium sulphate, may be marketable at a price sufficient to pay the cost of treatment. Practicable safeguards can be put into effect, the writer thinks, to prevent the slight danger of poisoning incidental to this method.

Economic Study of Highway Design and Location

Considering Distance, Grades, Alignment, Width and Surface in Respect to Cheap Operation of Motor Vehicles

Condensed from a paper presented at the annual meeting of the Minnesota Federation of Architectural and Engineering Societies.

By O. L. Kipp
Construction Engineer,
State Highway Department of Minnesota, St. Paul, Minn.

In economic highway location the first consideration is to secure the shortest line possible commensurate with other governing factors. Counting the cost of operation only and making no allowance for saving in time, the value of highway distance saved is approximately 10c. per vehicle-mile. On this basis the saving of one mile in the length of a road, assuming an operating period of 250 days per year, would be as follows:

Cars per Day	Saving per Day	Saving per Year	Capitalized Value at 5%
100	$10	$2,500	$50,000
1,000	$100	$25,000	$500,000
10,000	$1,000	$250,000	$5,000,000

It will be seen from these figures that the reduction of distance to a minimum is amply justified even though the traffic may be comparatively light. With extremely heavy traffic the theoretical amount which might be expended in order to save distance becomes almost unlimited. In seeking to save distance the necessity of serving intermediate communities, towns and cities cannot be disregarded. An effort must therefore be made to appraise the relative volume of traffic from such intermediate communities, or between such towns and cities, as compared with through traffic.

Economic highway location requires also that proper consideration be given to the topography of the country. Under this phase of the problem the following are the main features requiring consideration:

1. Other things being equal the location should be chosen over a route offering the best soil conditions.

Open porous soils should be chosen in preference to heavy sticky soils; firm ground in preference to swamps with deep soundings, and earth excavation in preference to loose or solid rock. These are not governing features but must be kept in mind and given due consideration.

2. The location should be chosen to provide economic grades.

This subject has been investigated at the Iowa Engineering Experiment Station. From this investigation a tentative conclusion is reached that the maximum economic grades are approximately as follows:

	Length, feet	300	500	1,000	2,000	3,000	7,000
Descending							
	Commercial, grade P.C.	7	5	3½	2.8	2.6	.....
	Automobile, grade P. C.	12	10	5½	4.2	3.3	.....
Ascending							
	Commercial grade P. C.	10	7½	6	5.3	5	4.8
	Automobile grade P. C.	...	13	10	8.5	8	7.3

It appears that descending traffic requires for economic operation considerably lower gradients than are required for ascending traffic.

It is considered that the growing importance of commercial highway traffic justifies the selection of 5 per cent as the standard maximum grade on the trunk highways and primary state aid roads of Minnesota. Special conditions may justify occasional exceptions to this standard. While steeper grades of less than 500 ft. in length might be theoretically economical, yet it appears that ordinarily the additional cost of locating and designing the layout to obtain 5 per cent as a maximum grade is so small as to justify disregarding any theoretical economy involved.

Providing the location is selected so that no change is required the establishment of easy grades is one of the most prominent features of highway construction. Alterations in grade as well as in alignment after a highway has been in service for a period of years can seldom be made without damage to improvements adjacent to the road. The initial establishment of easy grades should therefore be given careful study both in location and design, and the easiest grades consistent with cost of construction should be adopted.

3. In co-ordination with the matter of grade selection is the elimination of *rise* and *fall*.

Such elimination is evidently valuable providing the distance is not increased. In the *Engineering News-Record* July 22, 1920, p. 171, Wilson G. Harger develops the principle that there is less potential energy wasted on a light grade than on a heavy grade and that the actual saving in operating cost by eliminating a foot of rise and fall over a hill is less important on light grades than on heavy grades. The following tables are taken verbatim or adapted from Mr. Harger's article:

DISTANCE EQUIVALENT TO ENERGY SAVED PER FOOT OF RISE

1-foot rise on 10 per cent grade = 40 ft. of level distance.
1-foot rise on 5 per cent grade = 20 ft. of level distance.
1-foot rise on 2 per cent grade = 5 ft. of level distance.

Referring to the table previously given for the value of saving in distance, the following table is derived:

CAPITALIZED VALUE OF SAVING 1 FT. OF RISE AND FALL WITHOUT INCREASING DISTANCE

(Based on car-mile operating cost of 10c. per mile)

Vehicles per Day (250 days per Year)	Yearly Saving			5% Capitalized Yearly Saving		
Grades P. C.	10	5	2	10	5	2
100	$19	9.50	2.40	$380	$190	$47.50
1,000	190	95	24	3,800	1,900	475
10,000	1,900	950	240	38,000	19,000	4,750

4. The cost of right-of-way must receive its due consideration in determining the location.

Where other factors are involved to any great extent it is necessary to guard against the tendency to give undue weight to saving right-of-way costs. Economy in this direction is most easily appreciated by the layman and particularly by the local interests more or less directly affected by location. There is a tendency—and in many cases more than a tendency—for pressure from this source to give to this phase of highway location undue importance.

5. The cost of structures required for stream crossings and railroad grade separations is frequently a deciding factor in determining the definite location of a highway.

Frequently the most satisfactory solution of this problem cannot be obtained without data based on several preliminary trial lines. Other factors being equal square crossings of streams and railways are desirable. It seldom happens, however, that other factors are equal, and in a large percentage of cases skew crossings provide the most economic layout. The cost of the structure alone, for the same length of clear span on a line normal to the stream or railroad, varies as follows:

90 deg.	100%
74 deg.	103.5%
60 deg.	115.5%
45 deg.	141.4%

Crossings of less than 45 deg. are seldom necessary as ordinarily this angle can be obtained by a modification of alignment involving a slight increase in curvature.

The growing importance of railway grade crossing eliminations has within the past few years brought this factor into prominence in highway location. In many cases it takes precedence over all other factors and justifies abandoning old lines of travel in order that a location may be selected eliminating crossings entirely. In other cases where the crossing must be made it involves a departure from a natural location to a line affording the best possible support for an overhead crossing or to a low line permitting an underpass. A locating engineer's instinct for the selection of routes where the topography affords easy grades and slight curvature must be modified in many cases by the necessity of striking into comparatively rough terrain where opportunity for a separation of grades is naturally afforded.

6. The question of alignment enters more or less directly into all other factors of economic highway construction.

The exact economic value of good alignment with easy curvature from an operating standpoint has not been determined for motor vehicles. Improved alignment ordinarily results in a saving of distance which can be evaluated as

previously indicated. Where hard surfacing will be required in the near future the saving in surfacing costs alone frequently would justify an improvement in alignment. For instance, at one point on Trunk Highway No. 1, there is at present a half-mile jog which involves two right-angle turns. By following a diagonal location requiring six acres of new right-of-way a saving in distance of approximately a quarter of a mile is effected, and the pavement area is reduced approximately 2,800 sq.yd. At $2.50 per square yard this reduced the paving cost $7,000. This would provide a very liberal allowance for right-of-way purchase and still show a profit without considering the operating saving, which based on 1,000 cars per day, would amount to $25 per day, and a capitalized value of $125,000.

The importance from the standpoint of pavement area, of reducing curvature where topographic features permit, is shown by the following comparison, the paving areas being taken between common points on the tangents:

	Right of Way	Pavement Area
90 deg. Angle		
20 deg. curve	1.536 acres	3,203.6 sq.yd.
7 deg. curve	4.260 acres	2,571.4 sq.yd.
Difference (taking all of corner)	2.724 acres (more)	632.2 sq.yd. (less)
60 deg. Angle		
20 deg. curve	1.384 acres	1,946.3 sq.yd.
7 deg. curve	1.299 acres	1,714.2 sq.yd.
Difference (4 rods only)	.085 acres (less)	232.1 sq.yd. (less)
30 deg. Angle		
20 deg. curve	0.658 acres	929.1 sq.yd.
7 deg. curve	0.649 acres	857.2 sq.yd.
Difference (4 rods only)	.009 acres (less)	71.9 sq.yd. (less)

The real value of well balanced alignment cannot be determined by the foregoing methods in many cases. Frequently there may be no economic justification for improving curvature other than the added safety and comfort to traffic and the desirability of balancing the design. For instance, why spend from $20,000 to $100,000 in effecting a railway grade separation for the sake of safety, and save a few thousand dollars by the use of cramped alignment in the approaches and thereby create, it may be, as great a hazard as the one which has been eliminated at so great an expense.

Width of Roadway—There is a tendency toward the choice of too narrow a roadway. The saving in excavation, assuming level cross-sections, is not directly proportional to the width of roadway. The following table illustrates the variation in yardage for various widths assuming the same profile and level cross-sections. The 30-ft. roadway yardage has been shown as 100 per cent as this is the standard trunk highway width in Minnesota and the yardage assumed is our present approximate average for this width:

Width of roadway, feet	30	24	20
Cu.yd. per mile	13,325	11,100	9,625
Yardage, per cent	100	83.3	72.3
Traffic capacity	100	50	25

The traffic capacity percentage has been chosen empirically, but it approaches closely to a true comparison. In view of these figures and the excessive cost of obtaining additional width at a later date it would appear that too many township roads are 20 ft. wide when they should be 24 ft., too many state aid roads 24 ft. wide when they should be 30 ft. and, by the same token, perhaps many trunk highways should be 40 ft. instead of 30 ft. It must be remembered that the subgrade is the foundation for future highway development and it is not economy to design it in such a manner that it will require rebuilding or expensive remodeling within a comparatively short period.

Substantial grading, where proper location has been obtained, is economical also on account of the greatly improved drainage and snow protection which may be obtained through the use of wide side-ditch sections. These may ordinarily be used without increasing the gradients or the rise and fall materially. Where rock excavation is not encountered the following minimum ditch widths and depths are being used on Minnesota truck highway plans:

Centerline Cut Below Natural Ground	Minimum Ditch Width at Grade	Minimum Cut Grade, 30-ft. Roadway	Width At Bottom Of Ditch
Less than 4 ft.	16 ft.	62 ft.	3½ ft.
4 to 8 ft.	13 ft.	56 ft.	2½ ft.
Over 8 ft.	10 ft.	50 ft.	2 ft.

Such ditch sections naturally result in a considerable yardage of excavation per mile. It must be remembered, however, that the cost of the grading per mile, where the work is finished to definite gradients and cross-sections, is by no means proportional to the yardage per mile. The combined cost per mile of finishing and of moving the outfit on and off of the work and from one camp site to another on the work, together with general overhead charges, are practically the same per mile on light work as on heavy work. The sum of these items amounts to approximately $900 per mile on trunk highway work. On the other hand greater efficiency of operation is obtained as the yardage per mile is increased. On account of these facts the following table applies very closely, the various other governing factors being equal:

COST OF GRADING PER MILE

Cu.Yd. per Mi.	Overhead per Yd.	Moving Dirt per Yd.	Total Rate per Cu.Yd.	Cost per Mile	Increase In Yardage %	Increase In Cost, %
3,000	$0.30	.50	$0.80	2,400.00		
6,000	.15	.35	.50	3,000.00	100	25
9,000	.10	.30	.40	3,600.00	200	50
12,000	.075	.275	.35	4,200.00	300	75
15,000	.06	.24	.30	4,500.00	400	87.5
25,000	.04	.20	.24	6,000.00	833	150

Types of Surfacing—By improving the type of road surface various economies in motor vehicle operation are effected, such as, a reduction in fuel consumption, a reduction in tire upkeep and a reduction in general car maintenance costs. The cost of road surface maintenance also varies with the type of surfacing.

Considering first the saving in gasoline the following data are taken from a paper by Fred R. White, Chief Engineer of the Iowa State Highway Commission:

COST IN SAVING IN FUEL PER MILE

Type of Surface	Ton-Mile Cost	Aver. Cost Per Vehicle-Mile	Annual Cost Per Mile, 100 Vehicles Per Day, 360 Day Year	Annual Cost Per Mile, 1,000 Vehicles Per Day, 300 Day Year
Earth	1.71c	2.33c	$699	$6,990
Gravel	1.15c	1.56c	468	4,680
Concrete	.77c	1.05c	315	3,150

	By Gravel Surface On Earth Road		By Concrete Surface On Earth Road	
	100 Cars	1,000 Cars	100 Cars	1,000 Cars
Annual saving	231	2,310	384	3,840
Capitalized value	4,620	46,200	7,680	76,800

To pay 5 per cent interest on bonds and retire them in fifteen years requires an annual payment of 10 per cent of the amount of the bonds. Disregarding any difference in maintenance cost the saving in fuel alone with an average traffic of 151 vehicles would pay for gravel surfacing at Minnesota's average cost of $3,500 per mile. Other savings would fully cover any added cost in maintenance on the gravel surface.

Gravel surfacing on Minnesota state aid roads costs on the average $2,300 per mile, which would be paid for by fuel saving of 100 cars per day. Assuming township gravel surfacing road costs to be $1,500 per mile the saving in fuel consumption on an average of 65 vehicles per day would pay for such surfacing.

In considering the saving in operating costs as between a gravel surface and a concrete surface there are three major items to be taken into account, namely, maintenance, fuel consumption and tire upkeep.

In regard to maintenance expense Minnesota Highway Department records show that the maintenance on the concrete road surface between Anoka and St. Cloud amounted to an average cost of $86.37 with an average daily traffic of 1202 cars. On Trunk Highway No. 1 between White Bear and Carlton, which has a gravel surface, the average traffic was 1,151 cars per day and the average maintenance cost per mile was $862.52. Assuming these costs would be relative to the amount of traffic and reducing them to the basis of 1,000 vehicles per day, we find that an average traffic of 1,000 vehicles per day could be carried on a concrete surfaced road with a maintenance cost of $72 per mile, while to carry the same traffic on a gravel surfaced road would require an annual expenditure of $750 per mile. The difference in the cost of maintenance for an average traffic of 1,000 vehicles per day is therefore $678 in favor of the concrete surfacing.

The saving in fuel consumption as previously given on an average traffic of 1,000 vehicles per day is $1,530. The saving on tires over a concrete surface as compared with costs on gravel surfaced road has been shown by actual records to average 1c. per vehicle mile. This on the basis of 1,000 vehicles per day amounts to an annual saving of $3,000. The total of these three items is $5,208, which represents the annual saving by an average traffic of 1,000 vehicles per day over a concrete surfaced road as compared with the cost of the same traffic over a gravel surfaced road.

Assuming $20,000 per mile as the difference between the cost of gravel surfacing and the cost of concrete surfacing it requires an annual expenditure of $2,000 to cover interest and sinking fund charges. On the basis of the saving in maintenance, gas consumption and tire upkeep of $5,208 per year for 1,000 vehicles per day, the saving in operation cost on 384 vehicles per day would pay for the cost of the pavement. On the basis of the saving in maintenance and gas consumption only the saving in operation cost on 906 vehicles per day would pay for the cost of the paving.

Some "Engineers" I Have Known

BY A CIVIL ENGINEER

I HAVE been much interested in the controversy over the use of the term "sales engineer" to describe a salesman who sells engineering products. I wonder, however, that no one has as yet done justice to the numerous tribe of "engineers" of one sort or another that infest the land. If it were not for the injury that is done to the name of a splendid profession, the individuals responsible for this sort of thing would simply make themselves ludicrous, but it must be remembered that one perfectly good word, i.e. "professor," has already become considerable of a joke through its application to all sorts of practitioners of all sorts of arts.

Not long ago, for example, a New York newspaper, under a head "Body Engineers Now Important," held forth to the extent of nearly a column. When I first saw the head I thought this was a new engineering title for quack doctors, but upon reading into the article I found that the "body engineer" is the designer of automobile bodies. The article itself, of course, was simply a "puff" or "write-up" for a specific automobile manufacturer, in the course of which it is explained that the "body engineer" devotes all of his time "to the improvement of the body, of the locks, the door and window fittings, and everything that concerns the comfort and beauty of the car." Another of the fifty-seven varieties is the "publicity engineer." A newspaper article refers, for example, to the "publicity engineer" for a theatrical company. This, of course, is our old friend, the press agent, exalted to a "professional" plane. Still another specimen is the "milk engineer." Just exactly what his function may be I have not been able to make out, as I saw the title used on the corner card of an envelope.

Another instance recently reported to me was that of the "income engineer," who turns out to be no less a personage than our old friend, the insurance agent, who doubtless derives much "swank" and effects many entrances that he might not otherwise enjoy through the use of his neatly engraved card bearing his name and his title, "Income Engineer." I have before me also a newspaper or magazine clipping which contains an advertisement for an "Institute" which conducts a course in dress designing and dressmaking. This advertisement features the genius of Emily, who built up "a most lucrative business" by "following out a tip from the Institute to use original advertising methods." She styled herself "clothes engineer," and accordingly hung out her shingle bearing the initials C. E. after her name. Probably others will be inspired to follow Emily's example. Not long ago a Middle West department store advertised, with considerable éclat, the services of its "window-shade engineer" who would be at the service of its patrons.

An unusually interesting case not long ago consumed considerable space in the principal New York newspapers, when the Society of Professional Automobile Engineers formally opened its club house in that city. This brand of engineers, be it understood, comprises chauffeurs in private employment. But let the president of the society explain. According to the newspapers he announced that "the organization was conducting a nation-wide campaign to eliminate the term chauffeur from usage and substitute 'automobile engineer.'" "There is a great difference between an automobile driver and an automobile engineer," he said. "Our organization is composed of professional operators of automobiles in private employment. It aims to place the profession on a higher plane and to protect its members from increasing laws levied on operation of automobiles." Taxicab chauffeurs, it is said, are not eligible for membership. Perish the thought!

The climax is capped, perhaps, by still another variety that recently took a full page in a magazine to tell of a "New Profession That Pays from $3,000 to $15,000 a Year." "An enormous untouched field," continues the advertisement. "No competition, a tremendous demand, no capital required. Can be learned in from two to six weeks. . . . This new profession offers its followers a position of dignity and independence, a free rein for initiative, and those other recognized advantages enjoyed only by professional men. Yet there is no long period of training and study extending over years, no poorly paid period of apprenticeship, as is the case with doctors, lawyers, and followers of the old-line professions. And best of all, there is practically *no competition.* This is one reason why those men who are now practicing this new profession are actually making more money than the average doctor, lawyer, architect or engineer."

This fortunate individual is the "exterminating engineer," who through his "knowledge of technical methods and special formulas" devotes his professional activities to "the scientific exterminating of insects, vermin and parasites." Shades of Watt, Smeaton and Noble! Little did the humble doughboy, attentively "reading his shirt" during the long winter evenings in French trenches, realize that he was founding a new profession! The exterminating engineer, we are told, has "no difficulty in getting business," but he is "not dependent solely upon his individual efforts"; for the new profession is backed by a "co-operative organization whose membership consists of men trained in the profession, The Exterminating Engineers of America." This organization, which maintains its headquarters in New York City, teaches men by mail and graduates them "in from two to six weeks as 'exterminating engineers.'" Then it helps finance them in business, appointing them its representatives in their own communities. The Exterminating Engineers of America, we are told, "are always on the lookout for live, progressive men to become affiliated with them. The membership fee is ridiculously low—a man can actually become

established in business for himself as an Exterminating Engineer," at a lower outlay of money than the average freshman in college has to pay for text-books and supplies alone." An advertisement for this same outfit in *The Literary Digest* tells us that it is a "national organization carrying on movement started by U. S. Department of Agriculture and Forestry."

And so it goes. These are only a few. Doubtless others of your readers have discovered other varieties and could contribute a specimen or two to this engineering Chamber of Horrors.

All this has a humorous aspect, of course, as is exemplified by James J. Montague in the following verses:

"No longer little Micky Hare,
Whose ways are mild and meek,
Will keep my clothing in repair
For fifty cents a week.
He now demands a larger sum,
Which I esteem too dear,
For lately Michael has become
A Pressing Engineer.

"The days when Tonio Dorio
Would clip and trim my lawn
And make my kitchen garden grow,
For ten a month are gone.
He now is making wads of pelf,
Takes contracts by the year,
And, on his billheads styles himself,
A Mowing Engineer.

"The lads from Greece who cleaned my shoes,
Once in a cheaper time,
Now with a haughty scowl refuse
My little proffered dime.
One sees them by appointment now,
They've risen, it appears,
And have become, so they avow,
Shoe Surface Engineers.

"Old 'Rastus Johnson comes no more
To take the cans away,
Or knocks upon the kitchen door
To seek his weekly pay.
He's found a means of getting his—
The dusky profiteer—
His card informs me that he is
A Garbage Engineer."

But we as engineers are painfully aware of another side that sooner or later may be of embarrassing, if not serious, consequence to us. What are we going to do about it? I do not know. For the present, I am simply a—"Fed-up Engineer."

Railway Accidents and Track Work

Three accidents noted in the summary of the Interstate Commerce Commission (Bureau of Safety) for the last quarter of 1922 are of interest in connection with track maintenance and work-train operation.

Work-Train Protection—The dangers incident to work-trains operating on main lines and the necessity of adequate protection for such trains are illustrated by two accidents. On the Florida East Coast Ry., on Nov. 2, the flagman of a work train was told to hold a regular train until 1:25 p.m. in order that the work train might get clear of the main line, but he claimed that the time stated was 1:15. As a result of the misunderstanding of verbal orders a collision occurred, causing three deaths and the injury of eleven employees. On the Southern Ry. at Sadieville, Ky., Nov. 14, the engineman of a freight train passed a block signal indicating "stop" and caused a collision resulting in the death of one man. It is pointed out that the engineman not only disobeyed the signal (which he saw) but disregarded the rules that permit passing such signals under certain conditions.

Broken Guard Rail—Absence of a frog guard rail, which had been broken by a train, caused another train to mount the frog and leave the track at West Bend, Wis., on the Chicago & Northwestern Ry., Dec. 14. One man was killed. The 15-ft. 100-lb. guard rail had been broken into fragments, but it was not determined what caused this or what train did the damage.

Diesel-Engine-Driven Centrifugal Pumps Irrigate 50,000 Acres in India

By J. A. Colaco
College of Engineering, Guindy, Madras, India

THE irrigation systems connected with the Godavari and Kistna Rivers constitute the largest of their kind in India, and have involved the construction of some of the most remarkable engineering works in that country. Of these the Divi pumping station is probably the most interesting, not so much on account of its magnitude but rather because by successfully adopting pumping for the purpose of large-scale irrigation it made a new departure in this field of engineering in India.

The Kistna River rises in the western Ghats at a height of 4,000 ft. above the sea and traverses the whole width of the South Indian Peninsula before discharging into the Bay of Bengal. About 40 miles s.s.east of a place known as Berwada where an anicut has been built across the river, the Kistna divides into two branches, the Puligadda and the Nagaya, between which is inclosed the island of Divi, 105 sq. miles in extent. It had been the purpose of the Madras Government for several years to make these rich deltaic lands available for cultivation by means of water drawn from the Kistna Eastern Delta Bank Canal by carrying the same over an aqueduct to be built across the smaller Puligadda branch. But this scheme was not carried into effect in view of the more accessible areas to be irrigated on the mainland itself.

The Divi pumping project works consist of a pumping station placed about a mile from the head of the island where the river water remains fresh and where the level of the country is sufficient for the main canal to command the whole area to be irrigated. The distributing system consists of a main canal about two miles in length bifurcating at the Avanigadda regulator and thereafter spreading into a network of distributaries irrigating about 50,000 acres of land. Statistics for recent years show the average area irrigated as about 30,000 acres, yielding a gross revenue of 117,000 rupees. The net revenue is 69,500 rupees which works out at 3.64 per cent on a capital outlay of 1,906,290 rupees ($635,000).

Pumping Plant—The pumping station is situated centrally on a supply or loop channel cut across the width of the island and connecting the two branches of the river. The maximum lift when the river is low is 17 ft. The pumping plant consists of eight sets of 160-b.hp. two-cylinder Diesel engines each direct coupled to a 39-in. centrifugal pump by flexible coupling to allow for slight settlement of foundations or unequal wear of the pump and engine bearings. The pumps are arranged in two rows of four units each with space for a ninth unit, and the suctions draw from two parallel culverts under the engine house, with intakes from the loop channel.

The pump delivery is into two masonry concrete channels running parallel to the engine house on either side and each of these leads to a 10-ft. Venturi meter with a throat ratio of 1 to 3 discharging 500 sec.-ft. with a head of 3 in. There are in addition two combined recorders and counters in the meter house each registering up to 2,250,000 cu.ft. per hour, these being connected with the outside of the meter pressure chambers by passages through which the pressure pipes are carried.

The cost of irrigating each acre of cultivable land fluctuates rather heavily, being dependent to a large extent on rainfall conditions. It varied from about 1.15 rupees in a rainy year to 1.54 rupees in a dry year.

Lengthening Bridge After Caving of Bank in Flood

Washout Caused 200-Ft. Gap Where 100-Ft. Span Had Been—Replaced by One 200-Ft. and One 60-Ft. Span

By B. H. Faber
County Engineer, Columbus, Tex.

Caving of the south bank of the Colorado River at Columbus, Tex., just where the main highway from Columbus to La Grange crosses, destroyed the end span of the bridge on May 5 last year and cut more than 100 ft. into the bank. In reconstructing the destroyed part of the bridge it was necessary to lengthen the structure to take care of the increased width of the river. As in many such cases, the washout was due to inadequate foundations. It is expected to prevent future scour of the bank by building a current deflector upstream of the bridge to divert the current away from the concave bank.

Fast work marked the reconstruction, a 60-ft. and a 200-ft. steel span being erected in ten working days, between Dec. 15 and Dec. 31, 1922, although riveting the spans took two or three weeks longer. An interesting job of underpinning also had to be done, because of scour under the main river pier.

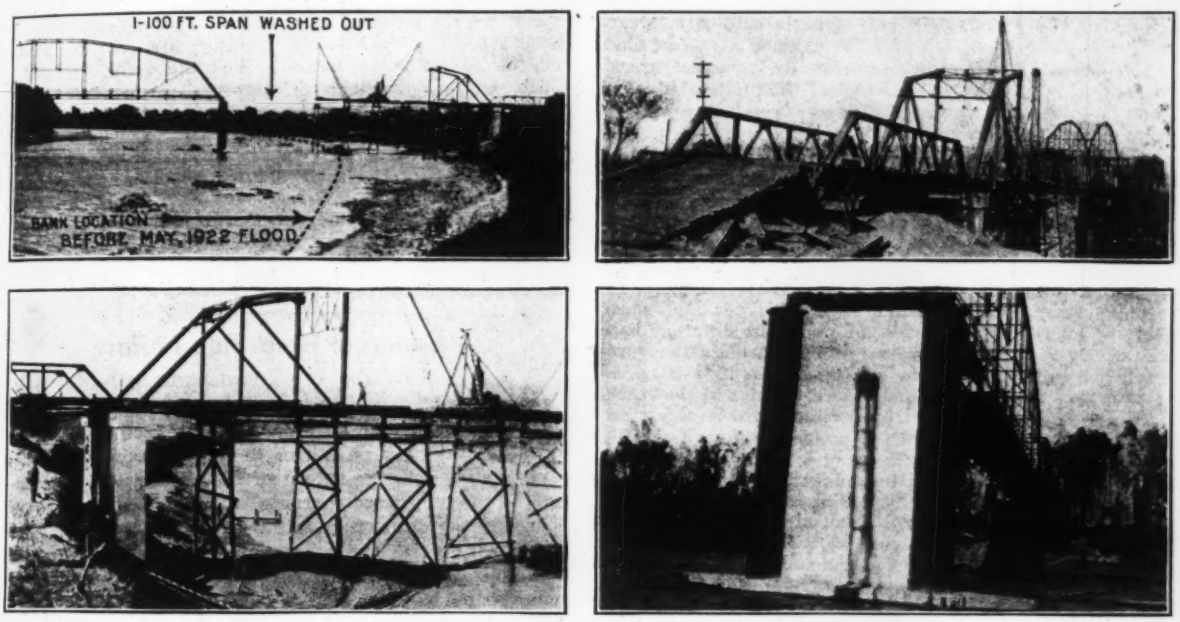
The bank of the Colorado River at this point is about 30 ft. high, the upper 15 ft. being clay while the lower 15 ft. is river sand, overlying a sand rock suitable for foundations. The south bank is the concave side, but the abutments at this end of the crossing have not been carried down into the rock. Beginning at the north bank the crossing consisted of three 180-ft. spans, which cross a sandbar or flood plain, a 240-ft. channel span, and a 100-ft. span. The washout of the south abutment carried out the 100-ft. span and, with continuing wash of the flood, a gap of 200 ft. or more was opened up between the south bank and the channel span. It was therefore necessary to provide a 200-ft. span and a 60-ft. shore span and to close the gap next to the channel span.

The new south shore pier, 49 ft. high, is a concrete pier set well into the sand rock. The south end of the 60-ft. shore span rests on a creosoted pile abutment. The new steel spans, built by the Austin Bros. Bridge Co., Dallas, were erected by light derrick travelers on pile and framed bent falsework. Their erection was completed on Dec. 31, as already noted.

Investigation of the south pier of the channel span, which consisted of two 5-ft. circular steel cylinders 20 ft. apart, sunk about 7 ft. into the rock and connected by a ½-in. steel plate web, showed that this web had buckled and that the downstream part of the foundation had been weakened by scour of the sand rock. To repair the damage a concrete base 11 ft. wide by 44 ft. long, pointed at both ends and faced with a steel nosing at the upstream end, was built around the bottom of the pier, to above low-water level. The steel web of the pier was incased in a 24-in. concrete web. The cost of this pier repair work, carried out by B. Fitzpatrick, of Columbus, was about $2,000. The rest of the reconstruction cost about $21,000.

It is now planned to resurface the deck of the bridge with a 4-in. creosoted floor of 3 x 4-in. x 18-ft. timbers, with an asphalt surface. Protection work will also be built above the bridge to divert the current to the center of the river as protection against future scour of the concave south bank.

During the time the bridge was out of service the county maintained a ferry across the river between La Grange and Columbus.



LENGTHENING COLORADO RIVER BRIDGE AT COLUMBUS, TEX., AFTER WASHOUT OF MAY, 1922

The pier carrying the south end of the 240-ft. channel span, lower right-hand view, was weakened by scour of the rock at its downstream side, causing the ½-in. steel web between the 5-ft. cylinders to buckle. This web has been protected by 24-in. concrete encasement. Future scour will be prevented by protection work above the bridge.

Economic Aspects of Treated Ties for Railway Track

Supply and Demand of Preservatives Discussed by Wood Preservers—Machine Boring and Facing—Spike Corrosion

THE relations of preservative treatment to the use of wood railway ties were presented from different points of view at the annual meeting of the American Wood Preservers Association and abstracts of three reports on this general subject are given below.

Boring and Adzing Ties Before Treatment—By boring spike holes and machine-facing the rail seats of ties before treatment there will not only be less chance of exposing lightly treated surfaces but there will be a deeper penetration of the preservative at the parts subject to wear. In this way increased life may be obtained at a cost that is nominal in comparison with the results. The mechanical operations may even be economical for untreated ties. These are the main points of a report based on replies to an inquiry.

Spike holes bored by machine are reported by different engineers to give better penetration of the preservative, a better grip on the spike, less damage by spiking and more accurate vertical position of the spikes. The holes are bored usually through the ties. One engineer suggests round spikes in bored holes of slightly less diameter than the spike. On the other hand, bored holes may cause trouble in widening gage and laying heavier and wider rails, or on roads where rails of numerous different base widths are used. However, one reply considers that pre-bored holes are desirable in any case, even if it is necessary to plug certain holes and rebore the ties in the track. Rail seats adzed or dressed by machine to a level surface for the rail or tie-plate give a better bearing, especially with hewed ties, which rarely have a plane surface. For sawed ties, however, the adzing might form an undesirable pocket to hold moisture, but would be necessary if rails are to be laid in canted position instead of vertical. One suggestion is that tie-plates should be secured rigidly to the tie by fastenings independent of the rail spikes.

Although both operations tend to material increase in life of ties they should be supplemented by the use of tie-plates to protect the wood from mechanical wear. Thus, one engineer refers to ties which last only four or five years untreated, eight years treated, and fifteen years when treated and tie-plated. The conclusion presented is that the largest return on the cost of treatment will be obtained by putting the ties through a boring and adzing plant before treatment and then protecting them with tie-plates of sufficient size and weight to distribute the load and prevent the rail from cutting and crushing the wood.

Prospects of the Tie-Treatment Situation—Although creosote oil is generally considered as the most effective preservative for timber, the increasing use of treated timber without corresponding increase in the production or importation of this oil has developed a situation which appears to necessitate the mixture of other suitable oils with creosote and also the use of other preservatives. In a paper by E. B. Fulks, of the Arkansas Preservative Co., St. Louis, Mo., it was stated that in 1921 there were used 48,000,000 gal. of domestic creosote oil and 28,000,000 gal. of imported oil, while there is little prospect of any material increase in the supply for several years. The use of creosote in 1909 was 83 per cent for ties and 17 per cent for other materials, but by 1921 these proportions had changed to 55 and 45 per cent respectively. It is estimated, therefore, that the supply will be sufficient for treating only 15,000,000 to 25,000,000 ties per year, while the railways will require from 60,000,000 to 75,000,000 treated ties, or about 55 per cent of their annual tie consumption.

Since the production of creosote oil (as a by-product) is controlled by factors independent of its supply and demand, the solution of this problem as suggested by Mr. Fulks is to restrict the use of creosote to situations where it is clearly necessary (as for permanent structures or in wet ground) and to use zinc-chloride more extensively where it is evident that it will give satisfactory results. He admits that the latter will not preserve the wood for so long a time as creosote, but considers that it will increase the life sufficiently to yield a good return on the cost of treatment. Further, he suggests that a comprehensive study of the use of zinc-chloride, such as has been made in regard to creosote, would develop improvements which would increase the value of the zinc-chloride treatment.

Corrosion of Track Spikes—That the use of zinc-chloride as a tie preservative has little or no relation to the corrosion of spikes in railway track is the conclusion of another committee's report. Of twenty-six railways which have experienced this corrosion where zinc-treated ties are used, only five reported this action as occurring in such ties only. Other factors in corrosion, as noted by the report, are the chemical composition of the spikes, electrolysis, brine dripping from refrigerator cars, cinder ballast, and the collection of water around the spike. Damage which appears similar to corrosion may result from mechanical wear at the contact of rail and spike. While the zinc-chloride treatment of times seems to hasten corrosion of spikes there are equally authentic cases where, under practically the same service conditions, no appreciable corrosion has occurred. In other cases, fully as much corrosion has occurred with spikes in untreated ties. It is therefore concluded that the situation is not serious and that where excessive corrosion is noted it would be well to look for causes other than the zinc-chloride.

A Concrete Roof-Slab Failure

BY DR. E. G. FRIEDRICH
Berlin, Germany

SOME weeks ago a fatal accident occurred in the Mosse Building, in Berlin, during the work of adding several stories to the height of the building. The addition is of reinforced-concrete construction, as are the floors of the four-story old building below. The two additional stories had been completed and the roof slab was poured. When the forms of the roof slab were removed part of the slab failed, and the falling masses broke through the two completed new floors below as well as the floors of the four stories of the old building. The old building was in continued service; fourteen persons were killed in the collapse and many seriously injured.

The accident points out once more that the roof slab in reinforced-concrete construction is apt to receive less attention than it requires. The safety factor of the roof slab is always less than that of floor slabs, because it is designed chiefly for dead-load. At the time forms are struck it is subjected to stresses approaching the final working stresses, which is not true in the case of floor slabs because of the absence of the live-load for which they are designed. Weather influences also are likely to affect a roof slab more than a floor slab.

Two changes in building practice are suggested by this accident. The first is to change the customary vague requirements to observe special caution in removing forms from slabs designed for small or no live-load. Repeated accidents have shown that this requirement is not sufficient, and that a definite minimum time should be specified, with a view to assuring safe strength of the slab at time of removing forms, under all conditions. This would call for a period of time two or three times as great as that necessary for floor slabs. The second change called for is the provision of special protection in the case of construction work over a building which continues in use.

Engineers Appointed to Retrace Oklahoma-Texas Boundary

Disputed Claims to Oil Lands in Big Bend Area to Be Settled in Accordance with Recent Supreme Court Decision

IN ACCORDANCE with a decision rendered in January by the United States Supreme Court, engineers who are to retrace the boundary between the states of Oklahoma and Texas, following the provisions laid down in that decree, have been appointed. These engineers are Arthur D. Kidder and Arthur L. Stiles, cadastral engineers, who have been requested by the court to locate the south bank of the Red River as it existed in 1821, which, under the court's decision, will be made the boundary between the two states.

Mr. Kidder is the associate supervisor of surveys of the General Land Office. He is the author of the Standard Field Tables used by the General Land Office and is editor-in-chief of the Board which is engaged in revising the manual of instructions for surveying the public lands of the United States. He is vice-chairman of the Board of Surveys and Maps of the Federal Government. The Supreme Court of Texas has based its opinion in a number of important suits on boundary surveys he has made, as has the Supreme Court of the United States, and in no case has the accuracy of boundaries been questioned. Since 1919 Mr. Kidder has been in general charge of surveying and mapping in the Red River area.

Mr. Stiles, the other commissioner, is the state reclamation engineer of Texas. He began work with the Topographic Branch of the United States Geological Survey in 1894. He surveyed the Glacier National Park and a large area in the Black Hills. He was in charge of the highly difficult boundary surveying in the Chisos Mountains of Texas in the Big Bend area of the Rio Grande, and he mapped the Fort Leavenworth area for the War Department; and has to his credit the surveying of the Sierra de Diablo in Texas and Jackson's Hole in Montana.

In 1909, Mr. Stiles was invited by the Governor of Texas to take charge of the levee and drainage work for the state. He organized that work and has been in charge of it ever since. Since the inception of the Red River litigation he has been in charge of engineering work in that connection for Texas.

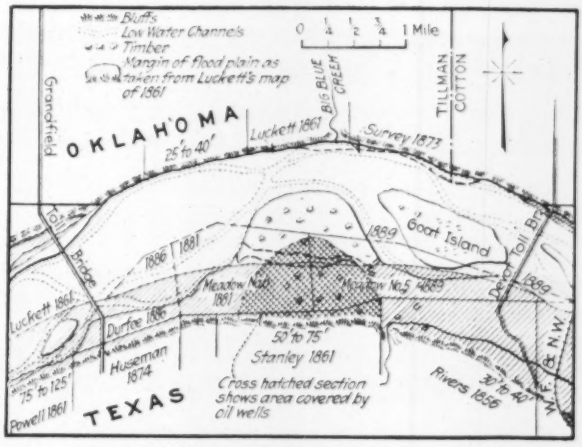
Retracing the state boundary has been made necessary through the placement on disputed ground of valuable oil wells. In accordance with the judgment of the court, only the Big Bend area of the Red River is to be immediately resurveyed.

The case before the Supreme Court involved the shifting channel of the Red River along its 600-mile course between the two states. Dispute as to the exact location of the state line was caused by the constant changes of the channel within the confines of the wide bluffs on the two sides. For much of the distance these bluffs are from 1¼ to 1½ miles apart, while the normal width of the river is slight.

For many years there was no controversy as to the boundary because there was little or no value to the land within the now disputed territory. Discovery of oil, however, led to the dispute and development of the Burkburnett fields in Texas. A prospector found that the oil extended five or six miles northwest of the Big Bend region of the Red River. Immediate drilling was begun and claims to oil lands in the basin became a subject of bitter controversy. Both Texas and Oklahoma lay claim to the area and both states sought to protect the claims of their respective citizens. The dispute was carried to the Supreme Court, Oklahoma becoming the plaintiff and Texas the defendant. The United States intervened in behalf of the Indians on the north bank.

In the presentation of the case a vast quantity of engineering work was required. Old surveys dating back to 1861 and embracing many private and official surveys of later dates were collected by the General Land Office to indicate meanderings of the stream at various times. These maps never agreed as to the location of the stream at low water and none of them with surveys made by the government after the controversy arose.

Ecologists from the U. S. Forest Service were called upon to establish the age of trees which had grown up in the lowlands for the purpose of showing that certain parts of the bed had become practically permanent ele-



OIL WELLS IN DISPUTED BIG BEND AREA

vations. Another exhibit was the development map showing the extent and location of oil wells in the river bed, this map indicating the existence of more than 100 wells in the basin in the Big Bend region.

In order to end temporarily the strife, pending settlement by the Supreme Court, that body took possession of the oil lands through the medium of a federal receiver. Operations were allowed to continue, the United States Government collecting the usual royalty of one-eighth of the proceeds from the sale of oil. Funds thus collected have been held awaiting judicial determination as to their ownership. That part of the court's decision referring to the disputed oil territory reads as follows:

The valley land always has been dealt with as upland. The United States surveyed and disposed of that on the north side under its Public Land and Indian laws and Texas surveyed and disposed of that on the south side under her land laws. Both treated the cut banks as the river banks and carried their surveys to those banks, but not beyond. Patents were issued for practically all the land. Individuals freely sought and dealt with it as upland. Much of that on the south side was disposed of by Texas fifty years ago, some of it seventy. Thousands of acres on that side were improved, occupied and cultivated under these disposals, and a larger acreage was occupied and used under them for pasture. Through the long period covered by this course of action there never was any sug-

gestion that this valley land was part of the river bed, nor that the shifting elevations of sand within the river bed were the river banks, nor that the land on the south side belonged to the United States. Not until some land on the south side and part of the river bed were discovered to be valuable for oil was this unbroken course of action and opinion brought into question. However much the oil discovery may affect values, it has no bearing on the questions of boundary and title.

Our conclusion is that the cut bank along the southerly side of the sand bed constitutes the south bank of the river and that the boundary is on and along that bank at the mean level of the water when it washes the bank without overflowing it.

The boundary as it was in 1820 when the treaty became effective is the boundary of today, subject to the right application of the doctrines of erosion and accretion and of avulsion to any intervening changes.

The treaty referred to above is that which was made between the United States and Spanish possessions to the southwest in 1819.

In the early stages of the suit the chief point of difference between the parties was that Oklahoma and the United States were claiming the south bank of the river as the boundary, while Texas maintained that the boundary was in the middle of the stream. According to the court decision "that difference was disposed in an opinion delivered April 11, 1921, wherein this court recognized that in the earlier case of the United States vs. Texas it had been adjudged that the boundary, as fixed by the treaty, is along the south bank."

The Supreme Court held that as to the line in question the definition still controlled, having been reaffirmed on several occasions but never changed. The Supreme Court decision, therefore, concerned itself with just what constituted the south bank of the river.

Twelve per Cent of Society on Committees

The Western Society of Engineers has thirty-three committees with 305 members, 12 per cent of the membership. Five years ago it had twelve committees and only 38 members. To advertise the work of the society to its members a series of single-page leaflets on the aims, history and privileges is being mailed at regular intervals to the members. This information on committee work and the 53-year old library with its 14,000 books visited by nearly 10,000 people yearly afforded two topics. Another theme was on the society's efforts toward unity and progress in engineering circles in Chicago for 53 years. "Many plans for needed civic improvements," it was stated, "have developed as a result of the deliberations of its committees and meetings. The broadening influence of trained minds meeting to extend acquaintance and exchange ideas has not been the least of our society's contribution to the progress of the second largest city in America." On committee work the work is visualized thus: "The program committee arranged meetings this fall that broke all records for attendance. The finance committee's balance sheet would delight General Dawes. The short story committee is causing many an engineer to dream of four-figure checks from magazines. The amendments committee is alive to changes in our needs. Twice this fall the noon-day luncheon committee has secured nationally known speakers who filled large ballrooms with eager engineers. The public affairs committee with its nine sub-committees and fifty-six members is making the voice of engineers heard in public affairs. Committhe work offers invaluable opportunity for engineers."

Refuse Collection and Disposal at Newark, England

INTERESTING features of the system of refuse collection and disposal practiced by the Borough of Newark, England, are the use of light Ford trucks for collection, a screening and salvage plant, and contributions by the national government to both the capital charges on the screening and salvage plant and the operating expenses.

The collection is made by means of one-ton Ford trucks with light tipping bodies, according to *Municipal Engineering & the Sanitary Record* of March 8. With an average haul of 1½ miles the annual cost of collecting 4,289 long tons of house refuse is given as £1,667, including licenses, insurance and capital charges on the trucks. The total mileage of haul was 10,301. The average cost of collection per long ton was 7¾s. ($1.70 per short ton). The gasoline consumption for the trucks was 1 Imp. gal. for 9-mile average haul.

Nightsoil totaling 1,728 long tons was also collected with one-ton Ford chassis on which were mounted light tanks. The total expense for this service was £802 for labor, £224 for transport, and £30 for disinfectant, making a total of £1,056, or about £1.63 per long ton of nightsoil. (At normal exchange, $7.93 per long ton or $7.08 per short ton.) The haulage distance for nightsoil collection totaled 5,392 miles.

The entire house refuse of the borough is screened and salable material is picked out.

Apparently the 4,289 long tons of mixed refuse yield on screening 1,380 tons of combustible cinders (about 30 per cent) for the Journal named above states: "No fuel is purchased, because 250 tons of screened cinders per year suffice, leaving a cinder surplus of 1,180 tons, which will be used in a 'turbine' forced draught furnace now being fitted to one of the water-works boilers. On the reduced coal bill the council will save £558 annually (evidently on water-works coal bill).

The salvage plant and connected buildings were erected "chiefly by direct labor" at a cost of £4,600 ($22,400) "towards which the unemployment grants committee (of the national government) contributed 65 per cent of the interest and sinking fund for fifteen years." The main items in the £4,600 just mentioned are £1,576 for land and building, £2,614 for machinery, and £339 for roads. In addition the government sanctioned a later loan of £200 for a tin baler. The screening and salvage plant was put in operation late in 1922.

Apparently based on some three months' experience, the cost of operating these works averaged 5½s. per long ton ($1.14 per short ton) towards which there is a government grant of 1s. per ton. Deducting this grant and 2½s. per ton (49c. per short ton) for reclaimed cinders, tin, bones, etc., reduces "the net actual cost of disposal to 1¾s. per ton, exactly the sum disbursed for labor."

Concrete Protects Against Aerial Bombs

According to a report recently issued by the British Fire Prevention Committee, in which the total number of air raids on London during the war is tabulated, a statement is made that with respect to air raid shelters examination of records shows that "a series of floors of concrete or reinforced concrete afford very considerable protection, and indeed on the lower floors absolute immunity against the average explosive bomb and almost entire protection on any floor against incendiary bombs."

Application of the Drop-Down Curve in Chicago Sewers

To Obtain the Desired Cover for the Aberdeen St. Sewer Through the Stock Yards, Drop in Sewer Was Introduced—Method of Design Given

By C. D. Hill
Engineer, Board of Local Improvements, City of Chicago

THE article on the "Drop-Down Curve in Conduits" by Prof. H. E. Babbitt in *Engineering News-Record*, Dec. 21, 1922, p. 1067, should be of interest to engineers who are called upon to design large sewers to drain low-lying tracts of land, where it is important that the roof of the sewer be kept as low as possible in order to obtain sufficient covering and where the conditions make necessary very sluggish velocities in the sewer. Chicago is about to construct one of the largest special assessment sewers yet built with the outlet end reduced in size for nearly a mile by taking advantage of the drop-down curve.

The theory of the drop-down curve has been applied to a number of sewer designs in recent years but the advantages of the application of this theory to sewer design are probably best shown by the proposed Aberdeen St. sewer. This huge conduit is intended to drain an area of 4,500 acres, and will discharge into the 39th St. conduit near the line of Aberdeen St. extended. It will extend southward from the outlet through the Union Stock Yards for a distance of 5,900 ft. to W. 47th St. and thence will extend south for a distance of 2½ miles to 68th St., where it will turn to the west and to the south.

From the outlet to 68th St. the surface of the street is so low that it will be difficult to obtain sufficient covering over the sewer, and for the first mile from the outlet through the stockyards it will be necessary to carry railroad tracks supporting the heaviest freight locomotives over the sewer in places and alongside it in other places. Because of this difficulty it was determined to employ a horseshoe shape of sewer, with a vertical diameter equal to 0.8 of the horizontal diameter.

The estimated runoff from 4,500 acres is 550 sec.-ft. and the estimated runoff from 4,000 acres lying immediately south of W. 47th St. is 500 sec.-ft. These quantities indicated a sewer of 15 ft. horizontal diameter by 12 ft. high with a slope of 0.00028 through the stockyards and a sewer of 14 ft. horizontal diameter by 11.2 ft. high with the same slope south of W. 47th St., these sewers flowing full with a velocity slightly in excess of 4 ft. per second.

It is impossible to build a sewer of the size indicated through the stockyards and keep the top below the bottom of the ties of the railroad tracks without placing the invert so far below the level of the water in the conduit as to produce stagnation and sedimentation during dry weather.

The application of the theory of the drop-down curve to the problem showed that the continuation of the 14-ft. sewer through the yards would carry 550 sec.-ft. with a depth of approximately 4 ft. at the outlet and slightly over 8 ft. at 47th St. and with a velocity increasing from 5 ft. per second at 47th St. to 10 ft. per second at the outlet. Further study showed that with 500 ft. of water flowing through the sewer south of 47th St. the depth of water would increase not more than 6 in. in a distance of 4,700 ft. where it was proposed to reduce the size of the sewer. Because of these computations it was decided to be perfectly safe to continue the 14-ft. sewer all the way to the outlet and to reduce the vertical diameter from 11.2 to 10.5 feet.

In this case the saving is not so much due to the decrease in the amount of material in the sewer as it is to the decrease in the difficulty of building so large a sewer through the stockyards, which are fully occupied, and where it is necessary to maintain traffic and support railroad tracks and other roads and structures.

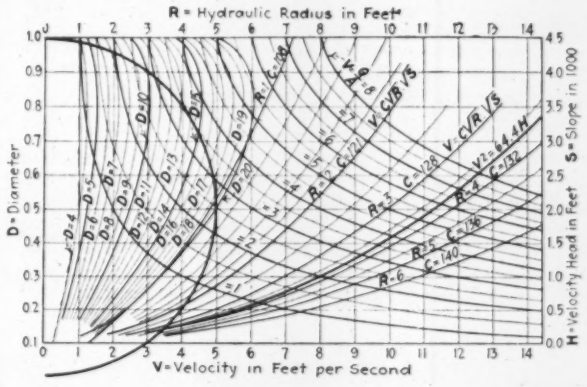


FIG. 1—HYDRAULIC ELEMENTS IN A CIRCULAR SEWER WITH UNIFORM DISCHARGE AND VARYING DEPTH

There is in addition the great advantage of obtaining better hydraulic conditions in the sewer during times of no rain.

A great deal of computation is required to determine the drop-down curve under any particular set of conditions. The greater part of the work is made unnecessary by the use of a diagram, Fig. 1, a description of which by the author was published in *Municipal and County Engineering*, April, 1920, and a computation sheet as shown in the accompanying table. This table shows the computations used in the case of a circular sewer 10 ft. in diameter, with a slope of 0.24 ft. in 1,000 ft. discharging 314 sec-ft. The earlier description of Fig. 1 follows:

The assumption is made that a constant volume of water is flowing through the sewer, that the depth of water near the outfall is a definite amount determined by local conditions, and that at an unknown distance from this point the depth of water is a definite amount slightly greater, the problem being to compute the distance. It is necessary to compute the wetted area at successive cross-sections of the sewer corresponding to assumed depths of water, to compute the hydraulic radius, the velocity, the velocity head and the corresponding slope at such cross-sections at each of which a definite depth is assumed, and from these elements to compute the distances between the successive cross-sections.

The distance between two cross-sections multiplied by the slope of the sewer, plus the difference between the depths of water at the two cross-sections, equals the differ-

ence between the elevations of the surface of the water at the two cross-sections. This difference must equal the head necessary to overcome the frictional losses due to the velocity between the stations, plus the difference between the velocity heads of the two cross-sections. This may be expressed:

$$LS_1 + (d_2 - d_1) = LS + (H_1 - H_2)$$

$$L = \frac{(d_2 - d_1) - (H_1 - H_2)}{S - S_1} = \frac{d' - H'}{S'}$$

By means of the diagram, Fig. 1, it is possible to read directly the hydraulic radius, the velocity, the velocity head and the corresponding slope for any cross-section through slope; the first two being indicated by the velocity ordinate and the curve, the corresponding slope can be read at the right margin of the diagram. The value of C corresponding to each value of R is obtained by Kutter's formula with a value of $n = 0.014$.

The process of computation is outlined under the heading of the accompanying table. It is not necessary to begin the computation by assuming the depth at the outlet. A beginning can be made at any depth, and the distances computed to the adjacent sections each way. It is well to take cross-sections at regular, frequent intervals of depth, say 0.02 of the diameter. Constant increments in depth will cause regular variations in

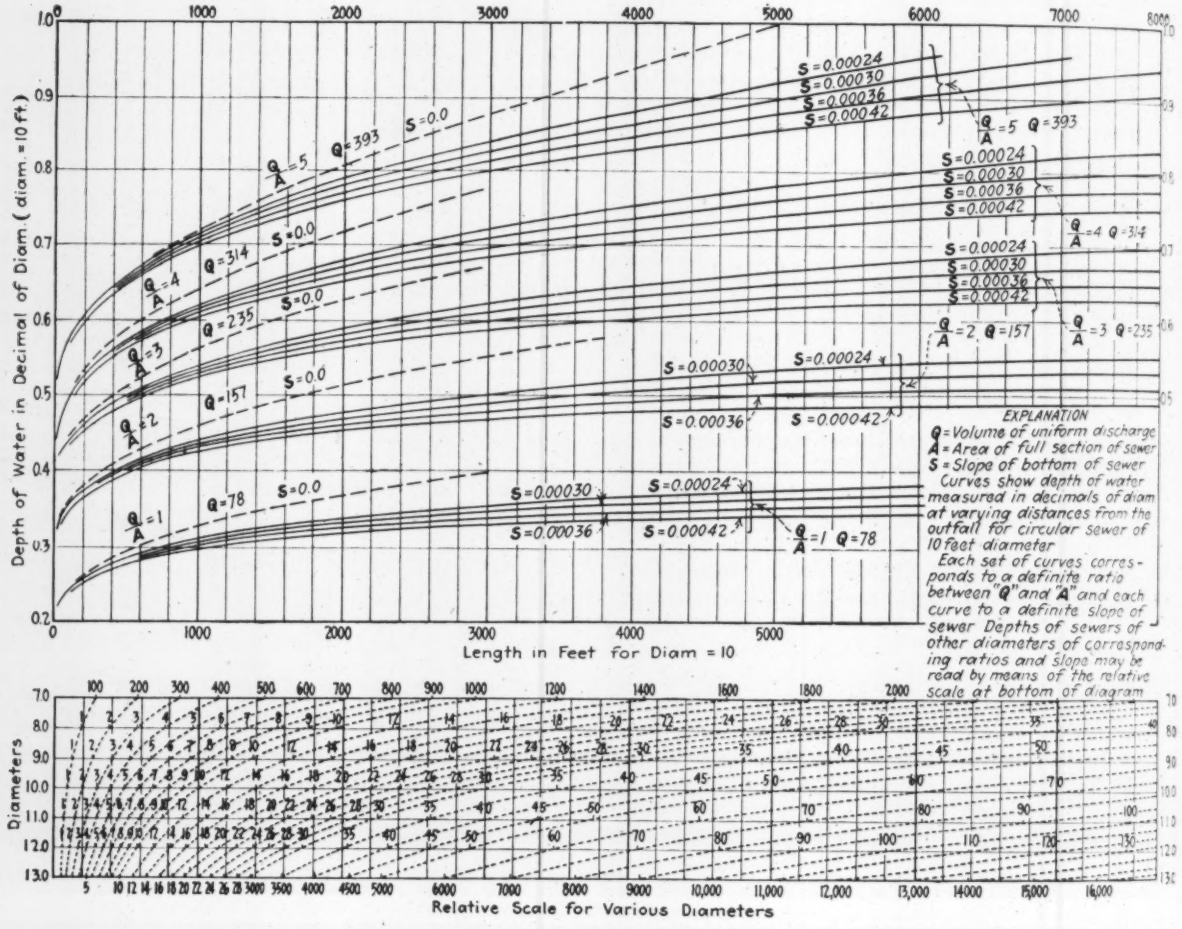

Depth of Water in Decimal of Diam. (diam. = 10 ft.)
Length in Feet for Diam = 10
Q/A = 5 Q = 393
Q/A = 4 Q = 314
Q/A = 3 Q = 235
Q/A = 2 Q = 157
Q/A = 1 Q = 78
S = 0.00024
S = 0.00030
S = 0.00036
S = 0.00042
S = 0.0
EXPLANATION
Q = Volume of uniform discharge
A = Area of full section of sewer
S = Slope of bottom of sewer
Curves show depth of water measured in decimals of diam. at varying distances from the outfall for circular sewer of 10 feet diameter
Each set of curves corresponds to a definite ratio between "Q" and "A" and each curve to a definite slope of sewer. Depths of sewers of other diameters of corresponding ratios and slope may be read by means of the relative scale at bottom of diagram
Diameters
Relative Scale for Various Diameters

FIG. 2—BACKWATER CURVE IN A 10-FT. CIRCULAR SEWER WITH RELATIVE SCALE FOR OTHER SIZES

which an assumed volume of water is flowing at an assumed depth.

On the scale at the left margin of the diagram is read the assumed depth of water expressed in decimal parts of the diameter. On the scale at the top of the diagram is read the hydraulic radius of sewers of various diameter at any assumed depth of water, which is indicated by the intersection of the horizontal line corresponding to the depth and the curve corresponding to the diameter.

The curves, $V = Q/A = 2$, etc., show the velocities, read at the bottom of the diagram, of a constant volume flowing at varying depths corresponding to the velocity of the same volume flowing through the full bore of the sewer.

The intersection of the curve $V^2 = 64.4\ H$ with the velocity ordinate shows at the right margin of the diagram the velocity head corresponding to the velocity.

The curves $R = 2$, $C = 121$, $V = C\sqrt{RS}$, etc., show the relationship between the velocity, hydraulic radius and other hydraulic elements, which serves to check the accuracy of the work.

The depth of water at the outlet can be readily determined with sufficient accuracy. Assume a depth, say 0.5 diameter; work down to a lower level until the distances between cross-sections become very small or a minus quantity. The control section is reached when the increment of the velocity head equals the decrement of the depth. As a matter of fact, in the case of a sewer having a free discharge, the depth of water at the actual outlet is of very little consequence, for the reason that the curve rises sharply and within a few feet.

In using the curve, Fig. 2, it is desired to know the depth of water at a distance of several thousand feet, or to find the distance from the outlet, where the

depth of water will be 0.6 of the diameter or 0.7 of the diameter, or something of that sort. Computation shows that for sewers 10 ft. in diameter these distances are in the neighborhood of from 2,000 to 8,000 ft. The error in computing the distance would probably exceed 10 per cent. This error permits us to exclude from consideration short distances of 50 or 100 ft. that may lie between the actual outlet and the lowest section used in the computation.

Where a sewer is partially submerged at the outlet, and the water level of the stream or lake into which it discharges is known, that of course would determine the elevation at the outfall. In Chicago, all large sewers discharge into the Chicago River or the Main Channel of the Sanitary District of Chicago, and the elevation of the water seldom varies more than 1 ft. from city datum. In a few instances where sewers discharge into pumping stations, it is possible theoretically to maintain a fairly definite water level by means of pumps, although in times of big storms this is seldom done.

The accuracy of the method is naturally no greater than the accuracy of the usual methods of determining runoff of storm water and the capacity of sewers. The probable error in computing the capacity of a large sewer that is yet to be built would certainly exceed 5 per cent if it did not exceed 10 per cent. The method of determining the drop-down curve depends upon the assumption that a definite amount of water is flowing through the sewer. This is a condition that may be approximated at intervals of time of very uncertain frequency. The method employed ignores disturbing influences such as the discharge of water from lateral sewers and house drains and assumes the construction of a straight sewer perfectly cylindrical in cross-section and of a known uniform smoothness of surface.

On the diagram, Fig. 2, is shown a series of curves showing depth of water measured in decimals of diameter at varying distances from the outfall for a 10-ft. circular sewer. Each set of curves corresponds to a definite ratio between Q, the volume of discharge, and A, the cross-section area of the sewer, and each curve to a definite slope of the sewer.

The distances from the outfall of similar depths of sewers of other diameters of corresponding ratios and slope may be read with a rough approximation of accuracy by means of the relative scale at the bottom of the diagram.

Fig. 2 gives some idea of the extent and limitation of the drop-down curve. It shows that for velocities (flowing through the full bore of the sewer) exceeding 5 ft. per second the curve rises rapidly, and the length of the curve is rather short. It shows that with sewers of small diameter, 5 ft. or less, the curve is quite short unless the velocities are low.

While the diagram is not accurate for diameters other than 10 ft. it will serve to show the probable value of the application of the drop-down curve to any particular problem that comes within its limitation.

TABLE—DROP-DOWN CURVE COMPUTATION SHEET
UNIFORM DISCHARGE—VARYING DEPTH

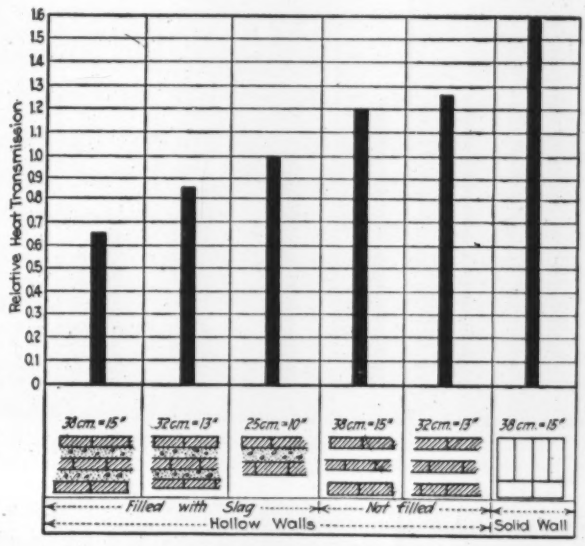
At the top of the table is recorded the diameter of the sewer in feet, the assumed volume of flow, the area of the full cross-section of the sewer, the velocity of the assumed volume flowing through the full bore of the sewer and the gradient or slope of the sewer. In the first column enter the assumed depth in decimal parts of the diameter for each cross-section; in the second column enter the same depth in feet; in the third column enter the difference in feet between the depths at successive cross-sections; in the fourth column enter the hydraulic radius corresponding to the depth at each cross-section; in the eighth column enter the velocity, equal to the volume divided by the wetted area, for each cross-section; in the fifth column enter the corresponding velocity head; in the sixth column enter the difference between the velocity heads at successive cross-sections; in the seventh column enter the difference between the quantities in the third and in the sixth columns; in the ninth column enter the hydraulic slope corresponding to the velocity and the hydraulic radius of each cross-section; in the tenth column enter the difference between the hydraulic slope and the slope of the sewer; in the eleventh column enter the computed distance between successive cross-sections; in the twelfth column enter the elevation of the bottom of the sewer at each cross-section, and in the thirteenth column enter the corresponding elevation of the surface of the water.

$D=10'$ $Q=314$ $A=78.5$ $V=\frac{Q}{A}=4$ per $1000'$ $S_1=.24$ $L=\frac{d'-H'}{S'}$

1	2	3	4	5	6	7	8	9	10	11	12	13
— Depth —											— Elevation —	
D	d	d_1	R	H	H_1	d_1-H_1	V	S	S'	L	Sewer	W. L.
42	4.2		2.22	1.60			10.06	3.00			—3.000	+1.2
		.40			.35	.05		2.60	2.36	21		
46	4.6		2.37	1.25			8.95	2.20				
		.40			.25	.15		1.92	1.68	90		
50	5.0		2.50	1.00			8.00	1.65		111	—2.974	
		.40			.185	.215		1.42	1.18	182		
54	5.4		2.61	.815			7.26	1.30		293	—2.93	+2.47
		.40			.135	.265		1.17	.93	285		
58	5.8		2.72	.68			6.63	1.04		578		
		.40			.11	.29		.94	.70	414		
62	6.2		2.82	.57			6.12	.84		992	—2.76	+3.44

Hollow Brick Walls Save Heat

TESTS of the transmission of heat through solid and hollow brick walls made by Prof. W. Knoblauch in Munich are summarized in the diagram below. They show a reduction of heat transmission by the use of a hollow wall as against a solid wall of the same thickness of 20 to 25 per cent, and further reduction of heat transmission if the spaces in the hollow wall are filled with slag. Hollow brick wall construction is coming into use in Germany, the 13-in. wall thickness being most common, and as the diagram shows this 13-in. wall has a much lower heat loss than a 15-in. solid brick wall. Dr. E. G. Friedrich, of Berlin, reports that the cost of mason work in brick dwelling house construction is 30 per cent lower for hollow walls than for the old style solid walls, which in connection with the heat saving action is expected to bring about a rapid spread of the new form of construction.



HEAT TRANSMISSION THROUGH BRICK WALLS
From tests of Prof. Knoblauch, Munich.

Arcades to Relieve Street Traffic —New York City

Plan for Widening Roadway to Include Present Sidewalks by Arcading First Story of Adjacent Buildings

By Arthur S. Tuttle
Chief Engineer, Board of Estimate and Apportionment, New York City

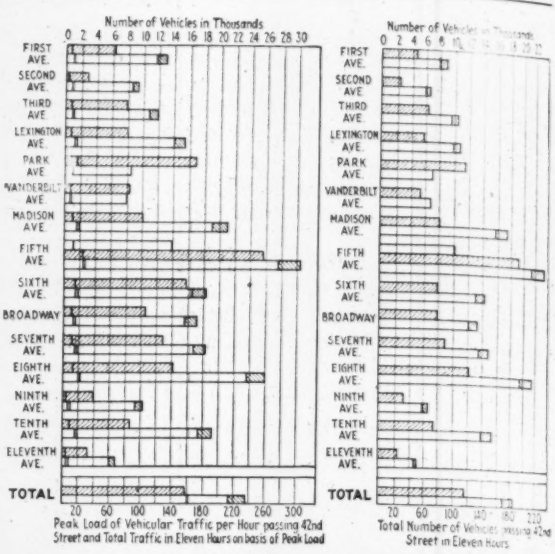
Extract from a report made March 28 to the Board of Estimate and Apportionment of New York City

As a substitute for the proposed plan of widening Vesey St. by taking land on the north side, the New York Telephone Realty Corporation, whose new building is planned to occupy the area proposed to be taken, has offered, without cost to the city, to arcade its first story, leaving the north sidewalk to be absorbed into the roadway. While the widening of Vesey St. has been considered as being wholly a local improvement, the proposition submitted, in so far as it relates to a method of accomplishing the widening, is of more than usual interest inasmuch as it presents an opportunity to illustrate the practicability of applying the arcading principle to other streets in the city where traffic congestion is pronounced and where relief under the usual method can only be applied at what might be deemed a prohibitive cost.

ARCADE CARRYING CHAMBERS ST. THROUGH MUNICIPAL BUILDING

Traffic counts on the line of all of the north and south avenues crossing 42d St., Manhattan, made on July 30, 1920, and on Dec. 20, 1922, together with a traffic count made at 5th Ave. and 42d St. in 1908, are shown in the accompanying drawings. With a traffic increase, even assumed to be at the present rate of 15 per cent, the seriousness of the situation which will obtain within the next few years becomes evident unless immediate steps are taken towards securing relief. Traffic congestion is also pronounced in certain streets in all of the other boroughs and it usually occurs in streets where land and building values are so high that relief through street widening can be secured only at very great expense.

As a means of providing relief in an effective way and one which would not involve the complete destruction of buildings or the withdrawal from taxation of large areas of great value, the arcade treatment has for a long time commended itself to your engineer, and with the thought



VEHICULAR TRAFFIC CROSSING FORTY-SECOND ST., NEW YORK CITY

White indicates traffic count taken Oct. 8, 1908, by Chief Engineer Board of Estimate and Apportionment (5th Ave. only) covering the period beginning 8:30 a.m. and ending 6:30 p.m. Charted to cover a period of 11 hours. Estimated as the total through traffic plus half the traffic entering and leaving 5th Ave. at 42nd Street.

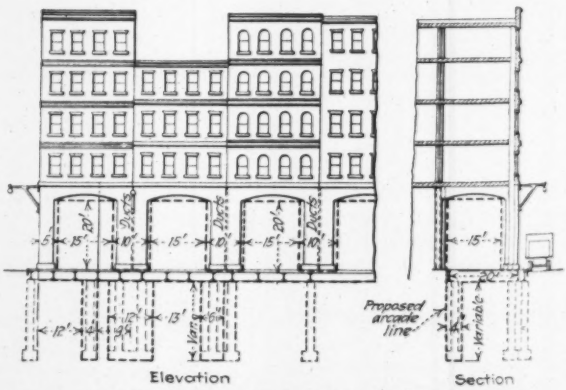
Right hatching indicates traffic count taken July 30, 1920, by the President of the Borough of Manhattan covering the period beginning 8 a.m. and ending 7 p.m. This count included all vehicles passing between 42nd and 43rd Streets except at Broadway and 7th Ave., where the count was made between 41st and 42nd Streets.

Solid black indicates traffic count taken Dec. 20, 1922, by the Police Department 14th Inspection District, covering the period beginning 8 a.m. and ending 7 p.m. This includes only vehicles continuing across 42nd St. except at Vanderbilt Ave.

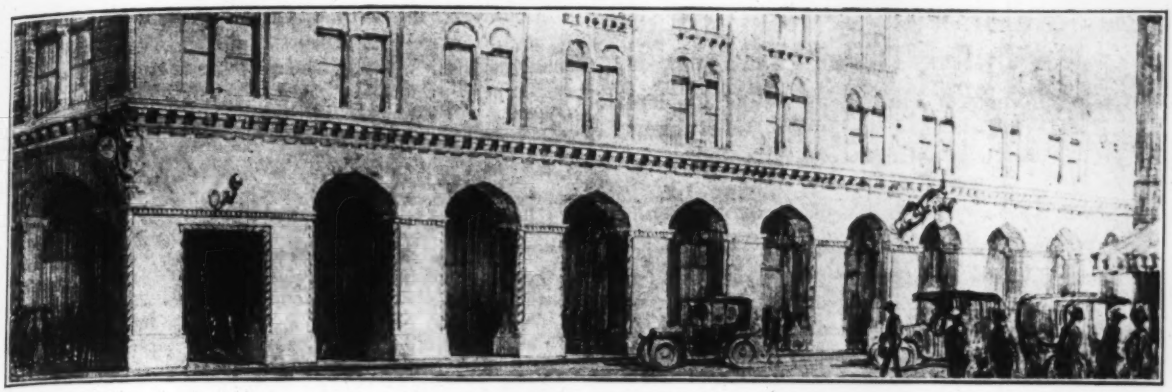
Left hatching indicates 10 per cent added to the Police count to cover estimated number of vehicles entering and leaving Avenues at 42nd St., this percentage being based on a study of the 1908 count.

more particularly in mind that for experimental purposes it might be applied to Nassau St., the width of which ranges from about 35 ft. to about 45 ft. and where congestion of pedestrian traffic is now so great each day that vehicular traffic is prohibited in the section between Spruce St. and Wall St. from 12 o'clock noon to 2 p.m. and from 5 p.m. to 6 p.m.

Few examples of sidewalk arcades are available in this country but the one through the Municipal Building on the line of Chambers St. conveys an excellent idea of the practicability of constructing such arcades without in any way detracting from the appearance of a building. The arcade effect is also well illustrated by the Madison Square Garden on the east side of Madison Ave. between East 26th St.



PROPOSED GENERAL PLAN FOR ARCADING BUILDINGS ON CONGESTED STREETS



PROPOSED ARCADE ON NORTH SIDE OF VESEY ST.

and East 27th St. This structure does not constitute a true arcade as there is no overhanging building, but the general effect is identical.

In order to indicate clearly the practicability of carrying out the arcade treatment under powers now enjoyed by the city, the accompanying drawing has been prepared, showing the general features of proposed street arcades and the extent of the public easements required to permit of their construction, and is intended to show the lines of separation between the public and private rights which

MADISON SQUARE GARDEN ARCADE FACING MADISON AVE.

would exist in the arcaded area. As indicated on the drawing, it is proposed, where conditions permit, to provide a width ranging from about 15 ft. to about 20 ft. for the arcaded area in streets where the depth of the lot is at right angles to the street line, and a width ranging from about 13 ft. to about 16 ft. in cases where the arcade would traverse the longer dimension of the lot, the rights to be taken by the city extending from a plane 3 ft. below the street grade to a plane adapted to the building development which has taken place or is expected to take place and shown on the sketch as 20 ft. above the street grade. The plan also shows the areas within the arcade which would be left in private use for the support of the overhanging building and the areas below the lower level of the arcade in which the city would have to take rights for the support of sidewalks in case it was not allowed to support them from walls or columns of the abutting building.

In taking easement rights of this character it is assumed that the city would secure all necessary authority for improving and utilizing the space reserved for columns in the arcaded area pending their construction, as well as the right to install in them street lighting facilities, fire pressure hydrants, fire alarm and police telephone facilities and mail boxes.

An inspection of this plan should make it clear that ample rights may be acquired by the city for an arcade without seriously interfering with the private utilization of the areas above and below it, but it should be understood that to accomplish this without undue damage to improvements the arcaded area must be so laid out as to conform as far as possible with the structural details of existing buildings. The plan also shows that it is proposed to place the curb line 3 ft. outside of the building line or the exterior of the arcade. This is a somewhat greater distance than is usually provided but it is not believed to be excessive, as it will serve as a safety zone for pedestrians and insure the building columns against injury from passing vehicles, which project far over the curb line.

From a study of the table showing the intensity of the maximum hourly traffic crossing 42d St. it would appear that through the installation of arcades on the line of each of the intersecting streets, it would be practicable to increase the number of traffic lanes from 55 to about 105, thus nearly doubling their capacity. It does not seem probable that relief to anything like this extent could be accomplished in any other way at a cost as low as would be the case with this method.

$750,000,000 For Railways in India

Railway rehabilitation costing $750,000,000 is to be carried out on the railways of India during the five years 1923-1927, this program having been approved by the Railway Board. This includes new rolling-stock and the completion of some lines already under construction, but extensions will be subordinated to the improvement of existing lines which have run down as a result of the war and subsequent financial conditions.

The rehabilitation work includes second, third and fourth tracks on main lines, putting heavier spans on long plate-girder bridges, enlarging and building new freight yards, improving numerous stations and station yards, and providing new water and coaling stations. Four new shop plants are to cost from $10,000,000 to $17,500,000 each. In addition there will be an enormous amount of track work to put the lines in condition for heavier engines and traffic. This work will include the substitution of 95-lb. for 75-lb. rails and 60-lb. for 50-lb. rails on 5½-ft. and meter gage lines respectively. One of the most extensive improvements will be at Bombay, including four-tracking, electrification for suburban traffic and new passenger terminals for two trunk lines. The largest single item in bridge work will be the double-tracking of the bridge over the Sone River, which is nearly a mile in length and has twenty-eight spans of 162 ft. c. to c. of piers.

Removal of Bracing Held at Fault for Fuller Tower Collapse

Twisting Failure of Tank Legs Found Responsible By H. G. Balcom—Ties as Well as Bracing Removed—Engineers Arrested

By Prof. Carlton T. Bishop
Sheffield Scientific School, Yale University, New Haven

THE ARREST of three engineers followed the coroner's inquest into the collapse of the tower of the Fuller Brush Co., of Hartford, which occurred on March 31, as described in *Engineering News-Record* last week (p. 674). These engineers are held criminally responsible for the death of ten men, and a charge of manslaughter is preferred against them. They are: Paul Sheldon, treasurer, and George L. Mylchreest, secretary of the firm of Buck & Sheldon, consulting engineers and architects, of Hartford, and Edward J. Vaughn, an engineer in their employ. Each was released under bond of $5,000, and the case will probably be called at the June term of the criminal superior court, under the law which provides a maximum penalty of $1,000 fine or 15 years in prison, or both. It has not yet been decided who will bear the financial loss of $40,000, or whether the Aetna Insurance Co. or others will seek to recover damages resulting from the loss of life.

It has developed that not only all the diagonal bracing rods between the tank columns had been removed or disconnected, but also that the horizontal channels between the columns had been removed. This left no steel members to resist the thrust from the inclined columns, dependence being placed upon the brick walls and the reinforced-concrete floor with the reinforced-concrete coping or girdle just above the floor as illustrated in last week's issue. There is evidence that the five 1-in. steel rods in this coping were not distributed as shown in the plans but were all placed at an elevation near the bottoms of the upper grillage beams. There is no evidence that these rods were overlapped or fastened so as to resist the thrust effectively.

Investigators Report—Reports have been made by Coroner J. G. Calhoun, by H. G. Balcom, consulting engineer, to Buck & Sheldon, and by A. S. Lynch, consulting engineer, to the city supervisor of buildings. Mr. Balcom believes that the collapse began with a twisting motion of the tank and its supports. He therefore concludes that the removal of the rods was the sole cause, so it was unnecessary for him to mention the removal of the channels inasmuch as they would not have prevented this rotating motion. The coroner asserts that both the removal of the rods and the removal of the channels were major causes. Mr. Lynch mentions both the removal of the rods and the channels and also the wall section as important factors. He offers two theories as to where the collapse originated, one that the steel supports failed due to the removal of the rods and channels, the other that the walls spread because they were not strong enough to resist the thrust from the columns. He inclined toward the latter theory, but not because of poor construction. The wall fractures indicated good construction, and this was substantiated by tests made upon samples taken from the ruins. Both the brickwork and the concrete developed strengths of more than 2,200 lb. per square inch in compression before fracturing. The foundations of the tower were apparently satisfactory, no settlement having been found by the city engineer.

Report of H. G. Balcom—Mr. Balcom in his report states that when he reached the site, Monday afternoon, April 2, two days after the collapse, what remained of the west and north walls of the tower had been dynamited and the tank had been cut up into sections and taken out of the wreckage. He continues:

> I examined the brickwork of the portion of the tower that was standing, and I also examined the brick and concrete work and the reinforcement in the rubbish, and from the condition of all this I found that the material used and the workmanship employed was first-class in every particular. I have also had the design of the tower and the tank carefully checked and find that the same, as designed, was amply strong for the purpose for which it was intended. The workmanship and material in the tank also were good, and therefore the cause of the accident cannot in any way be attributed to any fault in this particular.
>
> From photographs of the tower taken after the accident occurred, it is clearly established that there was no failure whatever of three of the supports. The only support which was destroyed by the accident was the one on the southwest corner. I also found that at least four of the diagonal rods bracing the tank tower columns had been removed and placed on the roof of the main building. I was also told by Mr. Vaughn, the inspector for Buck & Sheldon, that the bottom connections of the remaining diagonal rods had been disconnected, thus making the rods useless as bracing. I found only one clevis connection of the diagonal rods on any of the columns. I carefully examined the connections where the rods were to attach to the columns and found no evidence whatever that would indicate that the rods were in place at the time of the accident.
>
> Analyzing the design, it is evident that the removal of the diagonal rods was absolutely dangerous and the only security against failure was the little help of the columns in bending, which could not be relied upon as of any material value, considering that the tank and its contents weighed nearly 250 tons.
>
> The failure without a doubt started by a slight twisting action of the tank on its support, which could continue but a short distance before absolute failure would start. This would have been entirely prevented if the diagonal rods had been in place. An evidence that this is what happened is shown by the fact that the left-hand column angle, as one faced the tank, in every case failed in tension, and the right-hand angle in every case failed in compression, indicating that the failure started by the tank starting to twist in a clock-wise direction. If the tank had failed due to the failure of the southwest support, the left-hand angle of the southeast column would have failed in compression instead of tension. Another evidence that there was a certain twisting of the tank is shown by the fact that the east side of the tank when it fell was turned toward the south.
>
> I therefore feel sure that this accident was caused solely by the taking out of the diagonal rods.

Coroner's Report—The coroner's report begins with a history of the collapse and a description of the tower including the statement that the design "was an approved and sufficient method which if completed would have made the tank perfectly safe, even though located in a tower at a height of 80 ft. from the ground." The report deals separately with the removal of the diagonals and the removal of the channel ties.

Concerning the removal of the diagonals, the report refers to the decision to use the space immediately underneath the tank as a salesmen's school-room, which was an afterthought on the part of the company. The engineers approved the proposal. The plan for the change included the addition of a ceiling just below the

bottom of the tank, a new floor and other changes. The coroner says:

As the tension rods would project somewhat into the room and as one rod would interfere materially with the use of a new stairway, it was considered whether they could not be removed, and the decision was left to the engineers, who decided that they could. The official who made this decision was Mylchreest, and the order was communicated to Vaughn. The latter caused the rods to be removed on March 30.

Discussing separately the removal of the 4-in. channel struts or ties connecting the tank columns near their base, the coroner states that when these channels were to be put in place, three of the four were 9 in. short, and six extension plates were made to enable them to be connected. These channels, after being fastened in place,

were subsequently disconnected, and both Sheldon and Vaughn knew the fact and the reason for it, and the channel irons could not have been unfastened without their knowledge and orders.

One of the dangers to be guarded against in the installing of a tank of this character is that of a tendency to a sidewise or lateral movement. It must be guarded against in an outside tank absolutely, but even in an inside tank the walls of such a tower are not an absolute protection. There is some danger of this sort in a tank installed 80 ft. high. It was this danger that the channel irons and the tie rods in combination were designed to meet. They were both essential to the safety of the tank. I do not believe that either could be dispensed with safely. To remove the rods when the channel irons were unfastened was to make disaster certain.

The high winds that prevailed March 30th and 31st hastened the calamity. Without any way of resisting the lateral movement, deprived of the only safeguards intended and once installed to hold it safely, the sway began and in less than twenty-four hours the tank fell and with it went the lives of the workers who were underneath.

Following his arrest, Mr. Sheldon declared that prior to the time when the tank fell he had no knowledge whatsoever that the channel irons had been removed. He further expressed his opinion that the removal of the channel irons was in no sense the cause of the accident. The coroner has stated that Henry R. Buck, the other member of the firm of Buck & Sheldon, was not held individually responsible for the collapse because he had, "so far as I can find, nothing to do with the plans for the Fuller plant in any way."

Flushing Mains Anticipating Filtered Water

Anticipating the delivery of filtered water into the water mains of Detroit, Mich., the water department began flushing the system as early as August, 1921. The engineering bureau lays out flushing districts and during the summer gangs worked all night. Formerly every house affected was notified. Now newspaper notices give the location of the flushing gangs, although the foremen notifies hospitals and other consumers using large quantities before he begins work. During the year ending June 30, 1922, according to annual report of George H. Fenkell, superintendent and general manager, the entire 103 miles of low service system, 163 miles of the intermediate and 12 miles of the high service, had been flushed. Experiments to determine the efficiency of flushing were made by cutting into the mains. Inspection indicated that all loose dirt had been removed but that the barnacles and a layer of the more solid sediment on the bottom of the pipe remained.

Germicidal Effect of Acid Mine Drainage in Pennsylvania

Heavy Reduction of Total Bacteria and Gas Formers on Adding Acid Mine Water to Sewage —Confirmation by Field Tests

By W. L. Stevenson
Chief Engineer, Pennsylvania Department of Health, Harrisburg, Pa.

Abstract of a paper read before the Pennsylvania Water Works Association.

INVESTIGATIONS made by the Pennsylvania Department of Health show that the acid drainage from coal mines exerts considerable germicidal action upon sewage and that streams heavily impregnated with acid mine drainage can receive, without creation of nuisance, far more untreated sewage than can normal or alkaline streams.

During the recent coal strike the coal washeries were shut down so that very little coal dust was present in the stream but the flow of acid mine drainage continued to be discharged. This condition afforded an excellent opportunity to make field investigations because the presence of sewage solids could be visibly observed in the streams. The Engineering Division of the Pennsylvania Department of Health, therefore, made field and laboratory investigations during May and June, 1922, along the Lackawanna River and in the North Branch of the Susquehanna River for a short distance below the mouth of the Lackawanna. This work was done under the general direction of C. A. Emerson, Jr., (at that time) chief engineer, F. E. Daniels, chief of the Laboratory Section and I. M. Glace, district engineer, by W. L. Long, chemist.

Laboratory Tests—Sewage was added in various proportions to typical samples of acid mine water. The sewage used had a total count of 6,000,000 bacteria per c.c. and gas formation was obtained from 1/1,000,000 c.c. samples. After only two hours contact with the acid mine water in ratios of one part of mine water and five parts of sewage the total count was reduced to 32,300 per c.c. and gas formation to 1/1,000 c.c. Two hours contact with a ratio of one to one reduced the total number to 3,600 and gas formation to 1/100 c.c. The flora surviving the disinfecting action were of a different character from those found in the undisinfected sewage. On the plates planted with the mixture of sewage and the higher concentrations of acid mine water most of the typical fecal lactose fermenters were absent. Gram positive cocci, spore forming bacilli and saphrophytic yeasts, molds and aerobic spreading forms were the only ones present.

Sewage obtained from a public sewer which received a small quantity of acid mine drainage was added to a typical mine water in various proportions. In this case the total number of bacteria had been reduced by the small amount of acid mine drainage in the sewer to 15,000 per c.c. but gas formation was obtained in 1/10,000 c.c. portion of sewage. In all ratios of mine drainage to sewage and with periods of contact of both one and three hours, total numbers of bacteria were reduced and gas formation almost eliminated.

The sewage used in these experiments had a turbidity which remained practically unchanged for several days. Its hydrogen-ion concentration was 6.4. The addition of one part of acid mine water to five parts of sewage changed the hydrogen-ion content to 5.3 and caused a flocculation and sedimentation of about 50 per cent of the original turbidity. The addition of one part of acid mine drainage to three parts of sewage gave a hydrogen-ion content of 4.4 and caused practically complete sedimentation of the suspended matter in one-half hour, producing a supernatant liquor of zero turbidity.

Finely ground anthracite coal was added to tap water and continued to remain in suspension. A series of concentrations were made varying from 0.1 gram to 10 grams of coal in 200 c.c. of water. The addition of an equal volume of acid mine water to all these samples caused precipitation of the fine coal within one hour. The presence of the coal

had no effect upon the hydrogen-ion concentration of the sample.

From these data the conclusion may be drawn that acid mine drainage has an appreciable germicidal and clarifying action upon sewage.

Field Studies—In order that these laboratory studies might be confirmed by field investigations, an approximate study was made of the conditions existing in the Lackawanna River which drains a part of the anthracite coal region. In general, the river has sufficiently high velocities to maintain in suspension sewage solids and fine coal. The yearly average rate of discharge of the river at Moosic is reported as 570 sec.-ft., with normal August-October flows of 125 sec.-ft. and low flows occurring every three or four years for periods of from two to three months of about 100 sec.-ft., the minimum recorded rate of flow being 74 sec.-ft. There are about 130 collieries and an urban population of about 320,000 on the watershed.

The large water companies supplying this territory distribute about 50 m.g.d. of which a fourth is used in the coal industries, thus leaving about 37 m.g.d. for domestic and manufacturing purposes. Much of this is discharged to the river in the form of sewage through about 75 sewer outlets located along the river from Pittston to Forest City, including 48 outlets in Scranton. It is estimated that about 7 m.g.d. of sewage is discharged into the river above Scranton, about 14.5 at Scranton and about 2.5 between Scranton and the mouth of the river.

The amount of acidity reaching the river from mine drainage and leaching from culm banks is not known. It has been estimated that 23,000,000 gal. of drainage was pumped from the mines per nine-hour day in 1913. Comparing the acid and iron content of the typical mine drainage and of the Lackawanna River above Pittston indicates a ratio of 1 part of mine drainage to 6⅔ parts of stream flow but none of these data can be considered accurate.

In practically all cases where the sewer outlet is submerged beneath the water of the stream the sewage cannot be detected either by sight or smell at any time of the year. The only places where nuisance is noted, even at times of low stream flow, are at sewer outlets which discharge on the bank of the river above the water line.

On Sept. 10, 1922, a special inspection was made of the Lackawanna River from the center of Scranton to the downstream end of the city. The mines had not yet resumed operation and the sewage of Scranton and other towns upstream was visibly evident in the water of the stream. At sewer outlets and where the sewage was discharged on the bank the typical sewage odor was noted. But at no place was any offensive sewage odor noted from the stream itself. At this time the rate of flow of the Lackawanna River at Scranton was between 65 and 70 sec.-ft., and the river was carrying at the lower part of Scranton the sewage of about 170,000 persons. This represents only 0.4 sec.ft. diluting water per 1,000 persons contributing sewage, a totally inadequate ratio of ordinary diluting water to prevent creation of nuisance.

Samples of the water of the Lackawanna River were taken above and below Scranton and near the mouth of the river. Some were plated within three hours of time of collection and others kept for twenty hours in the ice box. Those plated promptly showed on the average about 2,500 total bacteria per c.c. on agar in 48 hr. at 37.5 deg. C., and the samples which were kept twenty hours were nearly sterile.

The sewage of the City of Hazleton is discharged into a small stream composed wholly of acid mine drainage. Samples of the combined sewage and acid mine drainage taken at a point where there had been about forty minutes contact showed a total bacterial content on agar in 48 hr. at 37.5 deg. C., of 1,490 per c.c.; 0.1 c.c. was the highest dilution in which gas formation was obtained. Samples allowed to stand in the laboratory for 18 hr. only showed 260 total numbers and gas in 1 c.c. Even in hot weather no nuisance from odors is reported from this flowing sewage and mine water.

These investigations have confirmed the policy of the Engineering Division of the Pennsylvania Department of Health adopted in July, 1920, worded as follows: "At points reasonably remote from water-works intakes, sewage may generally be discharged untreated into these streams, but preferably from the outlets of the several drainage areas into the main current of the stream so as to prevent local nuisance and to more efficiently distribute the sewage in the streams and thus take full advantage of the germicidal action of the acidity."

Serious Water-Borne Typhoid Outbreak at Cochrane, Ontario

TEMPORARY lowering of a "lake" storing spring water for the supply of Cochrane, Ont., so as to reverse the flow through the "lake" outlet and admit sewage-polluted water to the "lake" is the cause of the serious typhoid outbreak now prevailing at Cochrane, Ont., which has already resulted in 660 cases and 20 deaths. The following account of the outbreak has been supplied to this Journal by F. A. Dallyn, director Sanitary Engineering Division, Ontario Provincial Board of Health:

The water supply at Cochrane is taken from a series of springs, and there is an auxiliary supply from the overflow from these springs, known as Spring Lake. During the past winter, which was preceded by a dry fall, and possibly, also, owing to considerable railway construction going on in that area, the capacity of the municipal system has been taxed to the utmost, with the result that the level of Spring Lake was depressed below that of the drainage area outlet. This outlet, unfortunately, connects with a lake receiving sewage. The whole area was under a heavy sheet of ice and snow. It appears that the pump attendant did not realize just what hazard he was placing the municipality in by lowering the level of Spring Lake to three feet below that of Sewage Outlet Lake.

The possibility of some such accident was discussed with the municipality last year, and a by-law was passed to provide for expending a considerable sum for further reservoir capacity for the spring and for developing the springs somewhat further. Unfortunately, the town did not proceed with that work, nor with the purchase of a chlorine feed apparatus, which, also, was recommended.

I was in the area just one week before the outbreak was known to exist, and in view of some diarrhœa that was reported on as being contracted in Cochrane, I wired the office to secure a machine and to have one of our own engineers bring it up and install it. The machine was shipped two days later and was installed and in operation some three days before the local authorities realized that they had a typhoid epidemic on their hands.

At the present time the outbreak has reached some 660 cases with 20 deaths. There are sixty emergency nurses in the town and seven extra doctors attending to the sick. The hospital accommodation of the town is nominally listed at 60, so a considerable number of secondary cases may be expected before the outbreak is checked.

Besides supplying an engineer to develop an auxiliary supply from another lake and to make recommendations as to curtailing the supply to the railways, and to adjust the chlorine dosage, the Provincial Board of Health has supplied the municipality with ten nurses to supervise and assist the municipal authorities in the control of the outbreak.

Potential Power of Salmon River, Idaho

The U. S. Geological Survey has issued a report containing maps and descriptions of 23 sites along the Salmon River in Idaho at which, it is estimated, nearly 400,000 hp. could be developed at times of low-water flow and nearly twice that amount at times of medium flow. The project suggested for one of these sites contemplates the diversion of the flow of Salmon River into the Snake by means of a tunnel 8 miles long, which would create a head of 430 ft. The report is based upon an extensive investigation made during 1921.

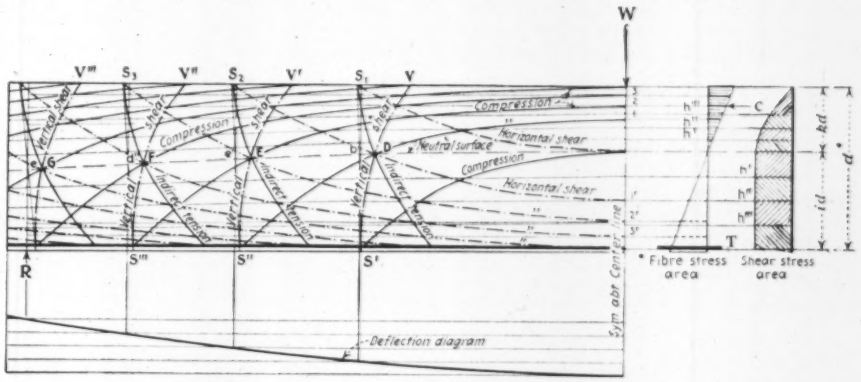
Engineering Literature

A MONTHLY REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

"Elasticity and Strength of Materials"

Sir—The writer submits that some mis-statements appeared in *Engineering News-Record* of Feb. 15, p. 312, under the title "Two Books on Reinforced Concrete," covering the writer's "Elasticity and Strength of Materials," and the earlier work, "Concrete Steel Construction," by the late Dr. H. T. Eddy and the writer.

"The twisting moment recognized by elasticians is essentially a rotation of an axis normal to the plate about itself as the plate is deformed"; "such distortion is ignored in the text and the twist has no place in the analysis," the reviewer asserts, and hence concludes the analysis is difficult to understand and lacking in connected logic. The fact is that these very twists are portrayed in "Concrete Steel Construction," Figs. 26 and 32, pp. 89 and 100, and over 10 per cent of the 400-odd pages are devoted to the correlation of these self-same twists with those about a horiztonal axis according to Kirchoff's theorem and as we know torsion operates in the shaft. Now the horizontal shears in vertical planes which produce this twist change sign in passing normal planes of symmetry and principal curvature, and it is by the application of this fundamental principle that the true bending moment is separated from the total applied moment, which embodies both bending and twisting couples.



STRESS LINES IN A REINFORCED-CONCRETE BEAM
(From advance sheets of Section II of "Elasticity and Strength of Materials.")

"Lateral deformation is absolutely untranslatable into stress," the reviewer says, the shades of Kelvin, Rankine, and Dr. Hooke to the contrary notwithstanding. Then he proceeds by informing us that an action similar to the lateral deformation occurs in a flat slab, and by restraining (?) this deformation the resisting power of the slab increases, notwithstanding its untranslatableness into stress.

"It must be remembered that no one has yet presented a successful solution of flat slab action." The authors, he says, are correct in emphasizing the difference between beam action and plate action but they fall into serious error in attempting to place the onus on the twisting moment. Here apparently is to be found the crux of the question. Plate action is the combined resistance of torsion and bending. Torsion or warping in a plate develops rotational shear strain of equal intensity about two orthogonal axes simultaneously, therein differing from bending or beam resistance. Torsion and bending each supply half the resistance, and while these resistances intermingle in the plate of ordinary thickness they may be separated or segregated into zones of diverse action in the simple experiment outlined in "Natural Philosophy," by Thomson and Tait.

By reducing the thickness to that of a very thin plate the length of the vertical element becomes so short that its torsional rigidity is far greater than the bending rigidity. Accordingly, the thin square plate suspended at opposite corners by vertical silk threads and loaded in like manner by light equal loads at the other corners will present the unique phenomena under twist and moment of half the plate remaining "infinitely nearly plane" (Kelvin) and the four corners only bending in cylindrical curvature. The areas of segregated twist are unbent. The areas of segregated bending stress are bent, a relation that can be explained by the analysis of Turner and Eddy.

With such defective grasp of the treatment his conclusion that the authors build a type that proves an apparent economy to the owner and seems to meet the qualitative requirement of flat slab action, for which in his opinion no successful mathematical solution has yet been presented, seems as far as one could logically expect him to go in his approval.

The confusion of ideas in the assertion that the spirit in which the books are written is that of justification of the mode of design of the patented mushroom slab when said slab is not mentioned anywhere in the text of the book "Elasticity and Strength of Materials" is difficult to account for in these dry Volsteadian days, and a like confusion appears in the vision of Eddy's unpardonable error.

"It is noted that the equality between vertical and horizontal shear is not valid" and without noting what the definitions are, that are carefully defined by symbol, phrase, and equation, he illogically inserts other and different definitions of his own and holds Eddy up as a blunderer on the basis of his diverse use of terms. The vertical shear S discussed by Eddy is defined as $S = \Sigma W$, i.e., vertical shear force producing clockwise rotation viewing the left half of the beam. And the

elastic horizontal shearing distortion measures the magnitude of the horizontal shearing stress, an internal shear strain producing anti-clockwise rotation, other than and different from the external vertical shear force. Proportionality between the two at the support may, but generally does not, occur.

The difficulty with the engineer and the theoretical writer as well is that approximate assumptions are too often treated as exact, leading to the multifarious errors of our Joint Committee on Concrete and the unfounded belief in that wonderful efficiency of the tensile stress in the concrete—after the embedment of steel.

A little diagrammatic analysis of these stresses shows that the curves of tensile stresses in the homogeneous beam have been displaced by curves of greatest shear (see drawing), and when the plate in all its phases has been worked out in the same detail such conflict of ideas as exhibited by the reviewer will be, let us hope, less commonly encountered.

He compliments Turner on the clear analysis of residual strain but hits the scientific thermodynamic foundation of the analysis he labels as clear. He fails to note the distinction between the kinetic and static moduli. Elastic strain is related proportionally to kinetic action; thereafter thermal change of radiation produces the static condition. In no other way than by this distinction may the variation in elastic coefficients caused by states of residual strain be investigated or rationally analyzed.

Fairness to Mr. Paaswell requires the frank statement that the writer regards his ideas of flat slabs as being about two generatios in advance of those of our Joint Committee. A more careful reading of the subject matter would undoubtedly dispel some of his doubts.

Minneapolis, Feb. 21. C. A. P. TURNER,
C. A. P. Turner Co., Consulting Engineers.

A British and an Indian Textbook

WATERWORKS FOR URBAN AND RURAL DISTRICTS: With Notes on the Supply for Mansions and Isolated Buildings—By Henry C. Adams, M. Inst. C. E., etc., Consulting Engineer. London and New York: Isaac Pitman & Sons: Cloth; 6x8 in.; pp. 230; 115 illustrations including three folding plates. 15s. $4.50.

ELEMENTARY SANITARY ENGINEERING IN INDIA: A Text-Book for Indian Sanitary Inspectors and others interested in the application of the science of sanitary engineering to tropical conditions—By George Bransby Williams, M. Inst. C. E., etc., Chief Engineer, Public Health Department, Government of Bengal. Second and Entirely Revised Edition. Calcutta and Simla: Thacker, Spink & Co. Cloth; 6x9 in.; pp. 124; 122 line cuts and half tones. Rs 6; 8s.

Of these two books the one on water-works by Mr. Adams is designed primarily as a textbook for students of engineering and the one on sanitary engineering is intended chiefly for the use of "candidates for posts as sanitary inspectors in Bengal," men with little or no previous experience in engineering. Mr. Adams reviews concisely and ably but quite briefly the theory and practice of water-works design. Mr. Williams treats of water supply, drainage, sewerage, sewage disposal, and building design. He also devotes a few pages to plans, drawings, mensuration, surveying and leveling. His volume contains many illustrations.

Both books seem well calculated to serve their purpose. Although neither has American users in mind each contains information regarding British and Indian conditions and practices that are of interest to broad-looking engineering and sanitarians in any part of the world. Mr. Williams, writing in India, seems to be more familiar with some phases of American water-works practice than does Mr. Adams writing in England, but this is a common difference between British engineers in the mother country and in the colonies. Finally, the book by Mr. Adams, like some of our best American textbooks, is serviceable to a considerable degree as an engineering reference book in its field, in so far as the subject can be covered within so narrow space limits.

Depreciation and Rate Making

REVIEWED BY LEONARD METCALF
Of Metcalf & Eddy, Boston, Mass.

RATE MAKING FOR PUBLIC UTILITIES—By Lamar Lyndon New York and London: McGraw-Hill Book Co. Cloth; 6x8 in.; pp. 209; 2 graphs. $2.

DEPRECIATION OF PUBLIC UTILITY PROPERTIES: Its Relation to Fair Value and Changes in the Level of Prices—By Henry Earle Riggs, M. Am. Inst. Consulting Engineers, M. Am. Soc. C. E. Professor of Civil Engineering, University of Michigan. New York and London: McGraw-Hill Book Co. Cloth; 6x8 in.; pp. 211. $2.

The difference in point of view of the authors of these two books is interesting. Lyndon states in his preface: "This book is intended to point out the logical and mathematically exact conclusions for each and every factor which enters into the consideration of valuation and rate-making and, without an assumption of omniscience, these conclusions appear to the author to be "unescapable." Riggs, on the other hand, says: "This work has been done as a part of a sincere attempt to find that middle ground of absolute fairness and justice which must be determined before the public utility issue may be considered as reasonably settled . . . The attempt is here made to trace briefly the history of regulation of utilities, to present, as the writer sees it, the true conception of 'Depreciation,' as that word has been used in valuation and regulation practice, and to point out certain important conclusions of the courts with which every one engaged in valuation work ought to be familiar . . . . The decisions are arranged in chronological order, since in that way they clearly show the drift of legal opinion as the subject of valuation has developed."

Lyndon says in his chapter on Reproduction: "The subject of valuation of public utilities is comparatively new and most of the present court decisions on this subject can be regarded as merely tentative. Certainly it is to be hoped that this is the case because most of them are contrary to logic and good business judgment." On the other hand, he commends highly the work of "the public service commissions, largely made up of experts in engineering and economics who have been especially trained for such investigations and for all kinds of valuation and rate cases constantly before them, and should, therefore, be best fitted to determine these questions" . . . Riggs, on the other hand, unfolds a beautiful story of progress by courts and commissions toward a fair solution of the problem, indicating what he believes to be the proper solution but frankly recognizing the uncertainty and so presenting his evidence that the reader may draw his own conclusions fairly.

In his discussion upon Depreciation, Lyndon treats the amortization of displaced equipment as return of investment to the owners—"they are not bound to reinvest these funds in any new machinery to serve a later generation of consumers unless they elect to do so."

Riggs on the other hand, constantly lays emphasis upon the continuing property—"the property so built is one instrument of service, and it is that property as a whole which must be considered and not the materials and machines and labor that enter into it . . . Property in maximum economic condition for service is the only thing which can be secured by investment. It must be kept in that condition by replacement of parts as they wear out. The obligation is to maintain. The manner of accounting for replacement is a matter of detail, not of principle."

Lyndon presents his subject in thirteen chapters covering The General Theory of Rate-Making; Depreciation, which it will be interesting for the reader to compare with Riggs' presentation; Reproduction, which he characterizes as highly speculative and in which he criticizes caustically the use of percentages in determining various overhead costs, although this is the practically uniform custom of engineers and contractors in their daily practice and operating experience; Valuation by the Historic Cost Method, which appeals to him as the soundest of all procedures; Intangible Values; Modifications of Capital Account; Rate of Return; Operating Costs; Increase in Population of Cities; and four chapters on Rate-Making for Gas Supply, Electrical Supply, Electric Railways and Telephone Service.

The book contains some inaccurate statements borne of the author's bias in favor of original cost as a basis of rating, rather than fair value as interpreted heretofore by the United States Supreme Court. His interpretations of the law and its intent are often not the interpretations of the higher courts. He fails to recognize that the courts are, in fact, but the exponents or interpreters of centuries of experience.

On the other hand, his discussion of a method of determining the rate is clearly and concisely presented. The treatment is necessarily elementary and didactic, no evidence being submitted indicating the fair range of basic variation of the units assumed by him. While some of the comments made will be challenged by experienced rate-makers, the presentation is interesting and suggestive.

Riggs, too, presents his subject in thirteen chapters followed by a valuable Appendix on Depreciation in the decisions of the Supreme Court and of the United States Courts. He covers successively Problems of Regulation; Investment in Public Utility Properties; The Interest of the Rate Payer in the Property; Operating Expenses, in which he points out the important differences between those which can be charged directly without causing any material fluctuation of ratio of operating expenses to gross earnings and those which cannot be so charged without violent fluctuation of the operating ratio, and he suggests the substitution for the word "Depreciation" of "Reserve or Allowance for Replacement or Retirement." In the next three chapters upon War Period Price Fluctuations, Fair Value and the Rate of Return, and Fluctuating Prices and Accounting Allowances for Replacement, he presents clearly the disturbing effect of the war upon methods of valuation, the apparent conflict in decisions and outlines the present issues.

Then follows a chapter on Supreme Court Decisions bearing on Depreciation and a discussion upon Divergent views as to the Propriety of Accounting Reserves. In Chapter 10, "The Uncertain Character of Depreciation Estimates" is discussed, and in Chapters 11, 12 and 13, upon Depreciation—Loss of Value which Should Be Deducted, Obsolescence and Conclusion, the author presents his constructive view as to the fair treatment of this important subject.

In the Appendix the decisions of the courts are well arranged in three periods: (1) Early Decisions Bearing on Depreciation Prior to the Adoption of Uniform Accounting; (2) Decisions Bearing on Depreciation Following the Adoption of Uniform Accounting; (3) 1914 to 1922—the Period of War and Fluctuating Prices.

Riggs' book is a masterly presentation of the subject of Depreciation Allowance and Accounting as it stands today before the courts and commissions. It is clear and judicial and will be found helpful whether one agrees fully or not with the author's views as to the probable outcome of the future. The book will be found suggestive and useful by courts, administrators and engineers.

Excavating Equipment

THE ENGINEERING OF EXCAVATION—By George B. Massey, M. Am. Soc. C.E., Western Soc. Engrs., A. A. E., Consulting Engineer, Vice-President, Randolph-Perkins Co. New York: John Wiley & Sons, Inc. Cloth; 6x9 in.; pp. 376; 196 half tones and line cuts, some of the latter on folding plates. $6. 30s. net.

On reading its title one pictures a rather broader treatment of its subject than this book gives. Only minor attention is given to organizing and planning excavating operations, on the economics of haulage, on the characteristics of materials and their management to facilitate excavation and removal, on drainage, on service operations and on plant selection, operation and maintenance. In the chapters on steam shovels and dragline excavators more engineering information is supplied than in any of the other chapters. These are largely descriptions of excavating machines except that the chapters on dredges discuss design and construction and describe equipment in a comprehensive manner.

There are twenty chapters. Of these the first five, relating to steam shovel and dragline work, occupy about 100 pages. Though devoted more than some might wish to descriptions of machines, these chapters contain much of value on selection, types of cuts, track arrangements, operation plans, performance, crews, and upkeep. The following six chapters on dry-land dredges, trench excavators, buckets, transportation, hydraulicking and drilling and blasting are all brief, aggregating 43 pages, and are almost exclusively descriptions of machines. The excavating engineer or superintendent, not a tyro at his work, will gain little from this part of the book. The succeeding seven chapters, occupying 165 pages, relate to dredge design and construction and in them the author shows his interest and qualification.

Dredges are discussed largely from the viewpoint of structure and equipment. There are chapters on hydraulic dredges, dipper dredges, bucket dredges, clamshell dredges, scows and barges, and two chapters on dredge hull construction. Drawings and specifications for both hulls and machinery are very complete. Performance records are given in a number of instances. There is a chapter on boilers, fuel, wire rope and one of 16 pages on "application of machinery to work," containing miscellaneous useful information and suggestions.

Government and Taxation

POLITICS: An Original Investigation Into The Essential Elements and Inherent Defects Common to All Present Forms of Government Together With a Proposal for a Political System Which Will Automatically Produce the Best Government Possible in Any Given Community—By Frank Exline. New York: E. P. Dutton & Co. Cloth; 6x8 in.; pp. 226. $2.

COUNTY AND TOWNSHIP GOVERNMENT IN THE UNITED STATES—By Kirk H. Porter, Ph.D., Assistant Professor of Political Science, State University of Ohio. New York: The Macmillan Co. Cloth; 6x8 in.; pp. 361. $2.25.

LOOSE LEAF DIGEST OF CITY MANAGER CHARTERS—By Robert Treat Crane, LL.B., Ph.D., Professor of Political Science and Director of the Bureau of Government, University of Michigan. New York: National Municipal League. 7x9 in.; pp. 200.

PUBLIC FINANCE—By M. E. Robinson, Fellow and Lecturer of Newnham College, Cambridge. With an Introduction by J. M. Keynes. [Cambridge Economic Handbooks]. New York: Harcourt, Brace & Co. Cloth, 5x8 in.; pp. 172. $1.25.

Four recent books presenting many important phases of government and public finance may be conveniently noticed together. Each contains facts and opinions that should appeal to any wide-awake engineer who is trying to keep abreast of the important governmental problems of the day, on the proper solution of some of which, at least, his bread and butter and even his welfare and that of his family may depend.

Mr. Exline in his "Politics" first presents a searching analysis of the science of government in which he reaches the conclusion that social and political justice can be secured only by government by law rather than by men; that just laws and their just interpretation must be based on reason rather than majority rule or power; and that all the functions of government—legislative, administrative and judicial—can be properly performed only by the selection of legislators and officials in accordance with their fitness for their respective tasks. He then outlines an elaborate system of examination or tests which, at least by implication, is designed to classify every adult person according to fitness for one or another place in the industrial and political spheres. In the application of the results of these tests no one would be allowed participation in any governmental function who has not qualified under some one of the *four* departments of government, Mr. Exline having added the department of *selection* to those of legislation, administration and judicial. The book is a strange compound of (1) logical analysis of government and (2) a scheme of reform based on an utter lack of recognition of the state of public opinion in general and of the individual human equation in particular. Nevertheless the book deserves careful attention because many of its fundamental ideas are sound while those that will seem unsound or impracticable—at least before the millenium—are profoundly suggestive. Even the visionary scheme for governmental reform—the elaborate ponderosity of which we have not attempted to outline—is based on the sound principles of fitness for governmental tasks to be undertaken, however humble, and on expert service.

Of a far different sort is Professor Porter's "County and Township Government," a book primarily descriptive in character, but not without statement of fundamental objects and principles, as well as suggestions for needed reforms. As adequately as could be expected without tedious detail, the volume pictures county and township government in the 48 commonwealths of the Union, both present and by way of origins.

Still closer to actual government than the book just outlined is Professor Crane's Loose Leaf Digest of City Manager Charters. The volume gives a page each to 166 city charters, besides which there are 24 pp. of Statistical Analysis and Comment and 5 pp. on The Manager Plan. The scheme for each city is to give the 1910 and 1920 populations, date of adoption of the manager charter, and main facts as the council, mayor, manager, administrative service and popular control by the initiative, referendum and recall.

For the most part, Professor Robinson's brief and readable essay on Public Finance deals with taxation, but it takes up borrowing as well. As is natural for a Cambridge University professor, the book is written largely from the British viewpoint, but few British authors show as much familiarity with American conditions as does this one. After an opening chapter on Expenditure and Revenue, the author considers taxation in relation to: Equity, practical problems, production, distribution, etc. There are chapters on local and on war finance, the post-war debt burden, both international and internal, and on future policies as to war debts, taxation and expenditures. In so small a volume it is impossible to give the wealth of historical and other data, and the weighing of theory and results of experience presented in the voluminous Essays in Taxation, by Prof. E. R. A. Seligman (see these columns, July 20, 1922, p. 115), but Professor Robinson's book has the advantage of brevity and homogeneity while that of Professor Seligman, valuable as it is, is a collection of essays, some overlapping others, and many not brought up to the date of the latest edition.

An Engineer a Century Ahead of His Time

ROBERT FULTON AND THE SUBMARINE—By Wm. Barclay Parsons. New York: Columbia University Press. Cloth; 7x10 in.; pp. 154; self-portrait frontispiece and other plates, mostly reproductions of Fulton's drawings. $4.

Robert Fulton's submarine, full details of which are now first made public, was a century ahead of its time. This was true politically for reasons that need not be gone into here, and technically because, although the submarine was well under control and proved capable of destroying a boat provided for the purpose, manpower only was available for under-water propulsion and a century was to elapse before mechanical power suitable to the purpose would be available.

Fulton went to England in the latter part of the eighteenth century as an artist; worked there as such but gradually turned to canal engineering; went to France to push small-canal construction; then plunged into submarine invention, construction and promotion. It was the rising power and ruthlessness of Napoleon that crushed Fulton's hopes both for his submarine and for the French Republic and finally turned him to England, to crush which country he had worked so ardently on his submarine. Under a salary of £200 a month from England, no petty fee even for those days, and with expense money as well, Fulton carried the submarine much farther for England than he had done for France.

By the irony of fate, only six days after Fulton and his submarine blew up the brig "Dorothea" in the presence of Pitt and others "came the great event that made secure England's control of the sea. Oct. 21 [1805], Nelson destroyed the combined French and Spanish fleets in the decisive battle of Trafalgar. After

that England had no need of submarines, torpedoes or Fulton."

After a disappointing year spent in trying to get what he considered to be a just settlement with England, Fulton returned to the United States and, in due time, achieved a success with his steamboat that had, perhaps fortunately for the welfare of humanity during the next hundred years, been denied him with the submarine. He left in England a full description of his submarine, and this, after more than a century, General Parsons reprints in his book, together with reproductions of a full set of drawings made by Fulton.

In bringing Fulton's "Descriptions" into print and telling not merely the story of Fulton's submarine in sufficient detail but also other interesting facts regarding Fulton as an engineer and as a man deeply concerned in the progress of humanity through the engineering and industrial arts, General Parsons has rendered a real service.

PUBLICATIONS RECEIVED

Notes on Pamphlets and Reports

TESTS OF ROAD BUILDING ROCK from many states, made in 1916-21, are tabulated in a 52-p. pamphlet issued by the United States Bureau of Public Roads.

PORT AND TERMINAL, a magazine devoted to harbor matters, has been selected by the board of directors of the Society of Terminal Engineers of New York as the official organ of the society.

A MATHEMATICAL STUDY IN TERRESTRIAL MAGNETISM (62 pp.) by George Hartnell, has been published by the United States Coast and Geodetic Survey under the title, Horizontal Intensity Variometers.

EXPERIMENTAL TOWBOATS, a letter from the Chief of Engineers to the Secretary of War consisting of reports on tests of heavy freight transportation on the Mississippi River, has appeared as House Document 108 (195 pp.).

CITY PLANNING AND ZONING PROGRESS in the United States down to April of this year is shown by states and cities in two pamphlets issued by the National Conference on City Planning (Flavell Shurtleff, secretary, 130 E. 22nd St., New York City).

METERED WATER RATES FOR DETROIT, by George H. Fenkell, general manager Detroit (Mich.) Water-Works, is a revised and corrected edition of a similar pamphlet issued last year. Besides a brief on proper meter charges for Detroit the pamphlet (68 pp.) contains citations from various authorities on the proper basis of charging for water.

AMERICAN ENGINEERING STANDARDS COMMITTEE (29 West 39th St., New York) has issued its 1923 Year Book, giving the report of the committee up to date. It includes a history of the body, the methods of operation, rules of procedure, standardization projects under way, and standards actually adopted.

ACTIVATED-SLUDGE STUDIES by the Division of Sanitary Engineering of the Ontario Provincial Board of Health fill about thirty pages of the 1921 report of the board (Toronto, Ont.) and with some studies of fly control and of sanitation of swimming pools make up Bulletin No. 8 of the division. There are papers on fertilizing values of, on iron in, and on gas evolved in the digestion of, activated sludge.

FOREIGN AFFAIRS, the new quarterly published by the Council on Foreign Relations, Inc. (25 W. 43d St., New York) has issued its third number. Senator Underwood's idea of the tariff as a factor in foreign trade; Professor Allyn Young on the United States and reparations; A. C. Bedford on the world oil situation; the Mexican difficulties, Germany, Pan-Islamism and Russia's economic policy make up the major part of the book, which promises to contain much of interest to those engineers who want to keep in touch with foreign conditions.

THE COMMITTEE OF MARINE PILING INVESTIGATIONS of the National Research Council, has issued in separate form its contribution to the report of the Committee on Wood Preservation of the American Railway Engineering Association submitted at the March convention of the latter. The pamphlet goes quite elaborately into the subject of marine borers, including biological studies, service tests, and notes on experiences in various parts of the United States. It is by far the most elaborate study recently made into the habits and actions of these marine pests.

THE MISSISSIPPI RIVER FLOOD SITUATION is taken up in four recent pamphlets. The first, by the United States Weather Bureau (Supplement No. 22, Monthly Weather Review) is a hydrologic record of the spring floods of 1922. A report by (then) Major C. S. Smith, Corps of Engineers, U. S. Army, on the surveys for spillways at or near New Orleans, La., made in 1914, has been issued by the Mississippi River Commission, whose annual report for 1922 includes a statement on the floods of that year. A fourth pamphlet is a government document (House of Representatives Committee on Flood Control) giving the record of the hearings on the Mississippi flood control bill passed by the last Congress.

New Books and Revised Editions

THE DOCK AND HARBOUR AUTHORITIES' DIRECTORY. Being a List of Members of the Docks and Harbours Throughout the World and of Their Principal Officials. London: The Dock and Harbour Authority. Flexible; 5x7 in.; pp. 193. 10½s. net.
Covers about 30 dock or harbor boards in the United States as against 16 in the 1922 issue, besides hundreds elsewhere.

ELASTICITY AND STRENGTH OF MATERIALS USED IN ENGINEERING CONSTRUCTION: Section II. Theory of Flexure—By C. A. P. Turner, M. Am. Soc. C. E., Consulting Engineer. Minneapolis, Minn.: The Author. Cloth; 6x9 in.; pp. 108; illustrated. $5.

FOUR LECTURES ON RELATIVITY AND SPACE—By Charles Proteus Steinmetz, A.M., Ph.D., Past-President, American Institute of Electric Engineers. New York and London: McGraw-Hill Book Co. Cloth; 6x9 in.; pp. 126; 32 line cuts and halftones on cards in pocket. $2.

LEHRBUCH DES HOCHBAUES—Herausgegeben von Esselborn. 3. bis 8. Auflage. Erster Band: Grundbau, Steinkonstruktionen, Holzkonstruktionen, Eisenkonstruketionen, Eisenbetonkonstruktionen. Bearbeitet von L. Brennecke, B. Kossmann, G. Ruth, H. Steinberger, R. Weder. Leipzig: Wilhelm Engelmann. Cloth; 8x10 in.; pp. 835; 2,342 line cuts.
The first edition was reviewed in this section of *Engineering News*, Oct. 15, 1908, and the second and much enlarged edition was briefly noted by Leon S. Moisseiff, Aug. 14, 1914. The present edition seems to be somewhat reduced in size.

MARKET MILK—By Ernest Kelly, In Charge, Market Milk Investigations, Dairy Division, Bureau of Animal Industry, Department of Agriculture, and Clarence E. Clement, Market Milk Specialist, Dairy Division, Etc. New York: John Wiley & Sons. London: Chapman & Hall. Cloth; 6x9 in.; pp. 445; 121 line cuts and halftones. $3.75. 18¾s. net.

METALS AND THEIR ALLOYS: A Modern Practical Work Dealing with Metals from Their Origin to Their Useful Application, Both Individually and as Parts of Alloys; Used Where Strength, Ductility, Toughness, Lightness, Color, Hardness, Cheapness, Conductivity, or Bearing Properties Are Demanded—By Charles Vickers, Specialist in Melting, Alloying and Casting Metals; Technical Adviser to Manufacturers of Non-Ferrous Castings, Non-Ferrous Editor of *Foundry*, and Metallurgical Editor of *Brass World*. Partly based on the Third Edition of "Metallic Alloys," by William T. Brannt. New York: Henry Carey Baird & Co., Inc. Cloth; 7x10 in.; pp. 767; 110 line cuts and half tones. Price $7.50.
After introductory chapters on the History, Production Methods, Properties and Use of the Elements, on Alloys in General, on Characteristics of Alloys and the Art of Alloying, there are 21 chapters on various alloys and chapters on surface coloring of Alloys, Foundry Utilization of Scrap Metals, Analysis of Babbitt Metals and Foundry Data.

STEAM POWER—By C. F. Hirshfield, M.M.E., Formerly Professor of Power Engineering, Sibley College, Cornell University, and T. C. Ulbricht, M.E., M.M.E., M. Am. Soc. M. E. Second Edition, Revised and Enlarged. New York: John Wiley & Sons, Inc. London: Chapman & Hall. Cloth; 6x8 in.; pp. 474; 252 illustrations. $3.25. 16¼s.
Besides minor additions and some corrections and rewriting in places for greater clearness, the chief change in this edition is a 25-page chapter on Performance of Steam Power Equipment. The first edition was favorably reviewed in these columns Feb. 15, 1917, p. 274.

VERMESSUNGSKUNDE—Von Martin Näbauer, Dr.-Ing., Professor an der Technischen Hochschule zu Karlsruhe. Berlin: Julius Springer, Boards; 7x10 in.; pp. 338; 334 line cuts.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

The "Romance" of the Everglades

Sir—Referring to the article describing a railroad location survey in the Florida Everglades in your issue of March 8, p. 459, I beg to advise the author of the article that the men engaged in that survey were pampered pets.

The writer was on one of those township and section surveys in the same territory. Instead of fifteen miles of survey in five days, we averaged fifteen miles of survey in one day, and our walking distance per day averaged more than twenty miles.

We lived on the same house tractor as described but it did not prepare a path for us. We cut and made our own. Our work was at right angles to the course of the tractor, it moving directly west about two miles a day while our surveys ran North and South.

When we went out in the mornings we had nothing to carry but the necessary quarter-mile stakes, section-corner pipes and sight laths for fifteen miles of line, in addition to grub sack, machetes and survey instruments. We could not be bothered with the tractor, our home, in sight at all times. We needed the extra thrill of looking for it after the day's work was done. Only one who has been among those countless coral islands can appreciate the intricacies of this game.

We had no attendant luxuries such as houseboat and physician, but we had boils aplenty.

You see we were working for a contractor and not a railroad.

C. B. BURNSIDE.

Potosi, Wis., March 15.

College-Trained Engineers for the Railways

Sir—I am heartily in sympathy with the editorial on "College Bred Engineers," in *Engineering News-Record* of March 29, p. 567. The railroads need college trained engineers to solve the problems of the railroads of today and the future, and the only way to meet this need is to make the railroad work attractive to the engineering college graduates. The engineering students must be fed in at the bottom, if they are eventually to come out at the top as trained railroad executives. With the many lines of work which are now opening up to the choice of the engineering graduate, it is going to become increasingly difficult to attract them to railroad work, unless there is a distinct effort in this direction.

W. A. ROGERS,
Bates & Rogers Construction Co.

Chicago, April 6, 1923.

Sir—The article in the *Engineering News-Record* of March 29, which calls attention to the reluctance of college men to take up railway work has been read with interest. The reason therefor seems to be implied in that sentence which states that a railroad is a poor place to work. Some of the disadvantages incident to a railway position on which such a reputation is founded are, as follows:

The inability of a railway engineer to establish a permanent residence and the difficulty in saving any of his earnings, due to the constant shifting from place to place and the justifiable fear of a sudden lay-off; the low salaries paid, for the amount and variety of work demanded; and slow promotion; the advancement of friends, relatives and satellites to positions of responsibility; the unpleasant atmosphere of the average railroad organization due to the bullying and insulting tactics of many railroad executives and their encouragement of such methods; the restricted field in that it is difficult for a man with any number of years of railway training to take up an allied branch of work.

The writer has been employed fourteen years with two railroads and the above seem to be the outstanding grievances of men with whom he has been associated.

April 3, 1923. "RAILWAY ENGINEER."

Maine Policy and Cheaper Highway Bridges

[*A policy of building cheaper highway bridges, recently announced by the state of Maine, was the subject of an inquiry addressed by "Engineering News-Record" to L. N. Edwards, the state highway bridge engineer, to bring out the means by which the intended economy was to be obtained. Mr. Edwards' reply follows.*—EDITOR.]

Sir—It is reasonable to assume that your inquiry of Mar. 29 refers to a news item which appeared Jan. 18 in a number of papers throughout New England, it having been distributed, I am informed, by the Associated Press. The origin of the news item can readily be surmised from the following quotation: "The Governor and Executive Council are convinced that there is no necessity of building such expensive highway bridges as has been done in recent years at all places in the State. Its members feel that thousands of dollars can be saved to the State and the public be equally well served by the erection of less costly types of bridges."

It is important to note that the news items have in every instance failed to give the information which is of vital importance to all bridge engineers, viz.: What basic load and strength conditions were assumed; to what extent was the service performance of the various types and classes of structures taken into account; were fire, flood, frequent repair and other hazards given due consideration, and, finally, were computations based upon such pertinent factors as original cost, safe service life, cost of maintenance, average annual expense, etc., involved in the economic consideration of bridge structures given full and proper consideration?

We feel that little, if any, real consideration was given to such important factors, for it is significant to note that the news item invites special attention to Martin's Point bridge on the Portland-Falmouth road and in this connection the claim is made that the structure "will serve all the demands of traffic for at least 20 years." This rather extravagant claim is made notwithstanding the fact that with the exception of a metal bascule lift span having a clear span length of 40 ft. the entire structure consists of an untreated wooden pile trestle with a plank floor. However this is not the most remarkable condition to which the news item directs attention for it further states that this pile trestle bridge, which has a total length of over 1,400 lin.ft., a width of 30 ft. and an average height of 20 ft. above the mud bottom of Presumpscot River, together with the bascule lift span cost $60,000. As a matter of fact the public records of Cumberland County show an expenditure of over $165,000 and in addition to this the Portland Street Railway Co. has expended over $20,000 upon the project. Incidentally the news item states that to have built at this location the type of bridge usually built by the State Highway Commission would have cost at least $1,000,000, but totally fails to point out the pertinent fact that the commission has never had this project under consideration either directly or indirectly.

The Commission's bridge division was in no way involved in the decision reported in the public press as quoted above. We know of no useful purpose it served but fully recognize that generalized statements of this kind appeal to the uninformed and serve to make more difficult the work of those whose energies are expended in producing highways and bridges involving the primary considerations of reliable and safe service, and economy in first and maintenance costs.

Your remark "Economy, especially in highway bridge construction, seems to be popular in the present year," refers, I assume, to the popular though intangible and altogether unreasonable idea that somewhere, somehow, someway there can be found a means by which we can design and construct

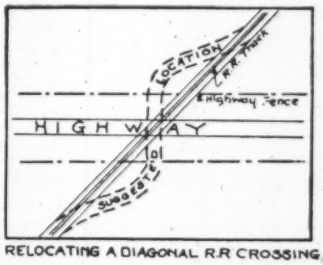
bridges having adequate strength to safely support, say, a motor truck load weighing 15 tons by using the same amount of material and paying the same cost price as were involved in bridge structures built 25 years ago to safely support horse-drawn vehicle loads weighing 6 tons. The creator or creators of this popular notion have failed to recognize the elementary condition that, speaking generally, "the stoutness of every member in a structure depends upon and bears a fixed relation to the burden it must bear."

It is obvious that economies in bridge design and construction, both in first cost and in subsequent maintenance, compel a careful consideration of types of structures, the materials to be used and the construction methods to be employed. These render the building and the rebuilding of bridges more than ever before the province of the capable and efficient bridge engineer. With his aid and assistance real economies can be effected, but upon highways involving the transportation of heavy motor vehicle loads so called "inexpensive" bridges are entirely out of place.

LLEWELLYN N. EDWARDS,
Bridge Engineer, Maine State Highway Commission.
Augusta, Me., April 6, 1923.

Relocating the Railway at Crossings

Sir—In your issue of March 22, p. 543, under the heading "Plan and Construction of Highway Crossings," giving specifications reported by the committee on Signs, Fences and Crossings of the American Railway Engineering Association and approved by the association as Recommended Practice, two sketches are shown, of which Fig. 2, "Relocating a Diagonal Highway Crossing," is described under the third paragraph of the specifications.



RELOCATING A DIAGONAL R.R CROSSING

In view of the fact that improved highways are being constructed today at great cost for the benefit of heavy and high-speed traffic, and that the machines which are run upon these highways are in many instances traveling at speeds as high as or greater than those of machines which travel on steel rails, and further, in view of the fact that these highways are being demanded and paid for by the public as represented by the government of the state and nation, and that the railroad is a corporation existing under and by the consent of said public, do you not consider that it would be advisable for the said committee on Signs, Fences and Crossings to reconsider the third paragraph of their specifications and also the design shown in their Fig. 2? It might be possible that they would take kindly to the suggestion of putting the necessary curves in their tracks rather than in the highway, in order to secure this right-angle crossing upon which they seem to insist—see sketch herewith.

T. M. RIPLEY.
Hornell, N. Y., March 23.

Sir—The suggested relocation of a diagonal highway crossing as suggested in a committee report of the American Railway Engineering Association, abstracted on p. 543 of *Engineering News-Record* for March 22, 1923, seems to me very unfortunate. Such a change was not so serious in the days of horse-drawn traffic, but in the days of swift motor traffic such a highway location introduces very grave dangers in the use of the highways. This is markedly so if the highway crosses below the railroad. In this case the vision of the highway ahead is obscured, so that if automobiles meet within the part of the highway shown in the figure, the driver of one car will not see an approaching car until just before it is met. The tendency also is for the driver not to stay on the righthand part of the highway and, due to obstructed vision, not to be able to get back onto the proper part of the highway before a collision with another automobile. These conditions are aggravated when the highway is on a steep grade.

Whether the crossing is at or below grade a sharp reverse curve is introduced which is very dangerous at the speed under which much motor traffic moves. Such a layout violates the first principles of highway location—that curves should be of gentle curvature, should not be sharply reversed, and should afford an unobstructed view of at least 300 ft.

Those who drive automobiles over roads with highways crossing railroads as outlined in the figure can testify to the apprehension with which such crossings are approached and to the sense of relief when they have been passed in safety. If any who are interested in this subject will visit Hanover I shall be pleased to show them, within a radius of fifty miles, five examples of highways located as shown in the sketch, which I feel confident will demonstrate conclusively to them the danger of such conditions.

CHARLES A. HOLDEN,
Hanover, N. H., Thayer School of Civil Engineering,
March 24. Dartmouth College.

Closing the Chicago River

Sir: Whether or not your editorial on "Closing the Chicago River" in *Engineering News-Record*, April 5, p. 609, was intended to provoke controversy, I am glad to note that you admit that "plenty of arguments will be found on both sides," and I am tempted to argue the matter.

In my capacity as member of several committees of several civic organizations in Chicago I have had occasion to report and to contribute to reports upon the various proposals to close the Chicago River. The following are some of the findings presented in these several committee reports:

1. The condemnation proceedings necessary to apply to the riparian rights involved before this plan could be put through, and the necessary act of Congress secured for the abandonment of the river for purposes of navigation, would both involve many years of delay before any practical improvement could be even begun. The adoption of the Hibbard plan means the abandonment of the South Water St. improvement. This delay would necessarily mean that the city would be left in its present condition for years without any possibility of vitally needed improvements.

2. The plan infringes upon the paramount public right in the navigable channel of the Chicago River. This right extends not alone to the local public, but to the public at large.

3. The plan is an infringement upon private riparian rights not alone in the section suggested for improvement, but also in the navigable channel of the Chicago River north and south of the central business district.

4. The U. S. Government has an investment of $1,800,000 in improvements to the Chicago River for purposes of navigation which would be abandoned by the adoption of such a plan.

5. The Sanitary District of Chicago has an investment of $12,106,282.41 in the improvement of the Chicago River for purposes of navigation and sanitation which would be abandoned by the adoption of such a plan.

6. The construction necessary to such a plan would be an impediment to flow of water in the Chicago River for sanitary purposes. Sedimentation occurring in the channel and obstructing the flow of water could not be removed from the section bridged over.

7. The plan would be a barrier to barge navigation from the Illinois Waterway, and it would not be possible to divert all of such traffic via the Calumet Sag Canal, which is not now navigable, without enlarging it at great cost.

8. The plan would deprive of water connections by barge with the Illinois Waterway, business and industrial concerns located on the main channel of the Chicago River, on the north branch of the Chicago River and on the south branch of the Chicago River in the section affected by the plan.

9. The expected use of the Municipal Pier, in which Chicago has an investment of $5,000,000, as a convenient transfer point of commodities between lake vessel and barge following completion of the Illinois Waterway, would be prevented.

10. The estimates of cost presented in the Hibbard pro-

posal are neither conclusive nor inclusive. The cost per mile would more likely run between five and seven million dollars than the figure of two and one-half million dollars suggested.

11. The interests of Chicago and the state are just now centered upon early completion of the Illinois Waterway, the obtaining of a 9-ft. channel for this waterway, and settlement of the old controversy over the flow of water to be taken from Lake Michigan. These latter two problems will require congressional action and any undue publicity or seeming public approval of the Hibbard proposal at this time might prejudice Chicago's chances of settling these problems, immensely more vital to its health and business prosperity.

12. At a time when the attorney generals of neighboring states are meeting in Chicago to plan court action inimical to Chicago's interests, we ought not to consider any proposal which may play into the hands of our enemies.

Further animadversion is suggested by your editorial, "the steep descending grade of shipping in the Chicago River since the eighties and nineties," does indicate the "ultimate abandonment of the River for shipping," for lake shipping, for use as a harbor for lake boatts; we must not lose sight of the fact that this is a transition period in the history of the Chicago River and its connecting waterways. It is obvious that the completion of the Illinois waterway will produce a large volume of barge traffic and that much of this traffic will be destined for industries located on and contiguous to the Chicago River and its connecting waterways. The completion of the St. Lawrence waterway will also add to the necessity for maintaining this barge channel in the Chicago River and its connecting waterways.

I believe that with certain due notice to the interests involved, it would be wise to anticipate the consummation of the transition in the type of shipping that is to use the Chicago River and its connecting waterways and to set a fairly definite date for fixing all of the present movable bridges across the river and that thereafter all bridges built should be of the fixed type. I do not believe that "the business building area has been restricted by the river to the north and west," as much as it has been by the union elevated loop railways. Business has already begun to move north and west and with fixed bridges the river would no longer be a barrier to the development of these districts outside of the loop. This whole matter should not be a subject of contention, however, but rather a subject of careful and disinterested study. To this end the Western Society of Engineers has recently contributed a most constructive suggestion; that is, the appointment of a body of competent engineers to study the question with legislative authority and appropriation.

ROBERT ISHAM RANDOLPH,
Consulting Engineer.

Chicago, April 12.

Winds and Barometric Effects on Great Lakes Levels

Sir—The paper of Prof. John F. Hayford on "Winds and Barometric Effects on the Levels of the Great Lakes" in *Engineering News-Record*, April 12, 1923, p. 665, is a valuable contribution to our knowledge on this subject and I am impressed by the thoroughness of the study. The method is logical. Without having checked any of the computations, but taking Prof. Hayford's statements at their face value, there is one point that seems to me to have the most economic importance. If it is possible to determine the surface level of Lake Erie as accurately from a single day of observation in Buffalo as it could formerly be determined from sixteen days of observation, the operation of regulating works to control the levels of the Great Lakes will be much simplified.

The Sanitary District of Chicago, in order to settle the controversy with the federal government regarding the lowering of lake levels, has proposed to install regulating works in the Niagara and the St. Lawrence Rivers, which would raise the present levels of Lake Erie and Lake Ontario more than 1 ft. and would more than compensate for any possible lowering due to the diversion of water through the Chicago Drainage Canal. The raising of the level of Lake Erie would automatically raise that of Lakes Michigan and Huron by back-water effect. The construction of such regulating works would not be a difficult matter, but the proper operation would be. To effect a change in the level of a basin as large as any one of the Great Lakes would require considerable time. Hence the necessity for predicting the natural change so that sufficient artificial change can be made, either to augment or compensate for, as the case may be. Therefore, if the level can be determined accurately by brief observation by Hayford's method and future levels predicted more closely by a study of weather conditions, the operation of regulating works would be made much simpler. In this matter alone the study made by Prof. Hayford would prove to be of great value.

H. P. RAMEY,
Assistant Chief Engineer,
Sanitary District of Chicago.

Chicago.

Why Not a Smaller Cement Sack?

Sir—I should think the ½ cu.ft. sack of cement mentioned in *Engineering News-Record*, March 29, 1923, p. 565, would be welcomed by contractors, particularly on small jobs. With the half-sack batch of concrete and often with the one-sack batch it is necessary for the laborer to divide the sack according to his judgment of what is a half sack. I have seen the following happen:

A one-bag mixer was being used. The material for one batch was delivered in two wheelbarrows. Half the aggregate and supposedly a half bag of cement were loaded on each barrow. Laborer "A" would put half a bag of cement and laborer "B" would put half *another* bag on their respective loads. On the next trip each would take what remained in his particular bag. If they had not done it this way laborer "A" would have had to handle a new sack of cement every time and "B" would have had to lift only half a sack each time. That isn't their idea of an even division of labor. It is evident that if half sacks of cement were provided a more uniform concrete would result than can be obtained by the method outlined above.

It would seem that the extra labor involved in having more packages to handle at the cars should be offset by the greater ease of handling.

L. W. MAHONE.

Ames, Iowa, April 2, 1923.

Sir—The question of the returnable cloth sack and the non-returnable paper sack is one which has been discussed up and down, in and out, over and under, pro and con for many years. It is true that sacks which for twenty years cost between seven and eight cents apiece now cost over twenty cents. We sell the cement at a price which *includes* a leasing charge for the sacks, and on return of the sack we allow ten cents. Of course we do not *sell* a sack which costs twenty cents for ten cents, but our gross charge is necessarily higher than it would be if we could buy new sacks for seven or eight cents.

Ninety per cent of our shipments are made in cloth, although in quoting we always give the customer the option of taking cement in cloth or paper or in bulk, and the fact that ninety per cent of our customers prefer the cloth is sufficient proof for us that that package is preferable to and more economical than the paper package.

As to reducing the quantity per sack to 50 lb. instead of 94 lb., I am sure that the cost of eight small paper bags would be as much as or more than the cost of four large paper bags, and I am also sure that the cost of packing and loading into cars would be greater with small bags than with large.

We will give the public any size or any kind of package it wants. We believe, however, that the public would pay more for cement if it demanded it in small packages than in large. In fact, the way we prefer above all other ways to ship our product is in bulk and when our customers permit us to do so, we make a price to them of five cents per barrel less than when they require us to put it in packages. This difference represents a little more than the amount we are able to save by handling the cement in bulk.

PRESIDENT OF A CEMENT COMPANY.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

News Brevities

Gross Revenue for the Year 1922 of $77,700,019 is reported by the Grand Trunk Ry. This leaves a deficit of $8,411,734, as compared with $14,064,442 the previous year.

Five of the Eight Units of the Chippawa development of the Provincial Hydro-Electric system are now operating, the fifth having been put in operation April 9. The total capacity of this development is now between 275,000 and 300,000 hp.

The Tennessee State Legislature has rejected a bill calling for authorization to issue $75,000,000 in bonds to complete the state highway system. Construction, as contemplated under the issue, aggregated 4,000 miles to be built over a 7½-year period.

The Denver & Rio Grande Western system contemplates the expenditure of $12,000,000 during the next fourteen months. This money will be used for the purchase of new equipment, the relaying of rails, the reconstruction of bridges and the construction of new shops.

Contracts Have Been Let and work has started on the electrification of the suburban lines on the southeast side of London. This section covers all the lines within a radius of 15 miles, and comprises 94 miles of double track and 200 miles of single track. In both speed and frequency the new service is intended to make a 30 per cent improvement over the present steam operation.

An Extensive Program of improvement work for the coming season, as prepared by the Pere Marquette R.R., includes the following items: Second main track from Delray to Plymouth, Mich., 19 miles, including grade separation at Michigan Ave., Detroit, $750,000; additions to shops at Wyoming Yard, Grand Rapids, Mich., $1,423,500; new engine terminal at Detroit, $1,000,000; new passing tracks at various points, $250,000.

Since There is Strong opposition to the proposal that Hawaiian Islands draw their highway funds from the general appropriation for Federal Aid, it is probable that no further effort to that end will be made. Because highways there must be constructed primarily to meet military needs, it is probable that a separate bill will be introduced at the forthcoming session of Congress. Subcommittees of the Committee on Military Affairs and of the Committee on Insular Affairs, accompanied by William P. Jarrett, the Hawaiian delegate, now en route to the Islands to make a study of the situation.

Dallas Votes $8,325,000 Bonds for Public Improvements

An increase in the bonded indebtedness limit of Dallas, Tex., from $14,000,000 to $25,000,000 and the issuance of $8,325,000 of new bonds, bringing the total city indebtedness up to $22,135,000 was authorized on April 3. The major part of the new bonds—$5,000,000—will be devoted to a reservoir and other improvements to the water-works. The present sewage disposal plant will be doubled in size and a pumping station built, there being an item of $500,000 for this purpose. For paving and other street improvements $1,250,000 was voted; for park improvements, $325,000; sanitary sewers, $150,000; new fire stations, $100,000; schools, $1,000,000. George D. Fairtrace is city engineer and Maj. W. J. Powell is engineer to the supervisor of public utilities.

Commerce Commission Places Value on Two Railroads

The Interstate Commerce Commission has placed a tentative value of $395,353,655 upon the Great Northern R.R. system, the largest railroad property yet to be valued by that body. This valuation does not include the securities of other roads held by the Great Northern which have an estimated net asset value of $227,076,317. The Great Northern values its own railroad property at $384,273,853.

The Commission's valuation of the Delaware & Hudson system, exclusive of certain coal land holdings and non-carrier property, is $95,834,979. On this same property the D. & H. places a value of $143,738,839.

Both railroad companies will protest this valuation as a basis of capitalization on account of their many outside holdings which have not been considered.

Distribution of River and Harbor Fund Expected by May 1

Washington Correspondence

The recommendations which have been made to the Secretary of War by the Corps of Engineers for the distribution of the $56,000,000 river and harbor appropriation will not depart materially from the division of the estimate submitted to Congress at the time the appropriation was under consideration. In some instances conditions have changed which will make readjustments necessary. It is anticipated that the Secretary of War will insist on a larger amount being expended on the Ohio River than had been suggested for that stream. This action, however, meets general approval in the Corps of Engineers, where there is a strong desire that the work on that stream be pushed as rapidly as possible. Final approval of the distribution of the river and harbor money probably will not be forthcoming before May 1.

Am. Soc. C. E. Board Meets in New Orleans

Committee Authorized to Confer With Other Societies on Public Affairs—Government Reorganization

Engineering News-Record Staff Report

The Board of Direction of the American Society of Engineers, in session in New Orleans, La., on Monday and Tuesday of this week prior to the opening yesterday of the annual spring meeting of the Society in that city, authorized the appointment of a committee of five to confer with other national societies looking toward co-operation on matters of interest in public affairs. The same committee is also given power to call upon President Harding and members of Congress in relation to the President's reorganization plan, embodied in a law passed by the latest session of Congress. The Board of Direction approved these recommendations as to government reorganization, particularly those tending to divorce civilian engineering activities of the government from engineering duties which are under military control.

Local Membership Committees

The Board also authorized the appointment of local committees for preliminary consideration of applications for membership, final action remaining with the Board, according to the constitution.

Early in the Board's session it was laid down as a principle that the committee on Professional Conduct would consider cases of violation of the code of ethics of the Society as abstract cases from which general principles are to be formulated, unless otherwise directed by the Board.

On reconsideration the Board decided to refer proposed practice as to code violations to committee for full report.

The committee on Registration of Engineers reported progress only, and action which had been ordered to be presented at the present session, was passed over until the next meeting. By resolution of the Board, at its meeting in New York in January, the committee on Registration of Engineers was instructed to present for the consideration of the Board at its meeting in New Orleans (See *Engineering News-Record* March 1 pp. 379 and 411) a method of procedure by which the Society might actively carry out a policy looking toward the establishment in all states possessing licensing laws of a uniform law acceptable to the Society. The committee was also directed to submit a draft of such a uniform law.

Secretary Dunlap, of the Society, was ordered to confer with the secretaries of the other founder societies in an attempt to set up a nation-wide paid employment service available to members. A report on this plan is to be made at the July meeting of the Society.

(*Continued on p. 725*)

Nationalization of British Highways Considered

Adoption of French System of Road Construction Is Being Urged By Local Authorities

London Correspondence

Adoption of the French system of road construction on a national basis throughout Great Britain is being seriously considered by many of the leading highway and urban authorities. Under the present scheme road construction is undertaken by local county councils and county borough councils with the co-operation of the Ministry of Transport. The cost is found partly by the Ministry and partly by the levy of a local rate; as a rule the Ministry finds from 25 to 50 per cent of the cost from the road tax and the balance is raised in the district of the local authority.

The complaint now is that the "dole" system maintains unemployed workers while funds are not forthcoming for the construction and improvement of highways. It is proposed that the unemployment dole should be turned over to the local authorities and used for the construction of highways.

A much discussed instance of the anomaly in existence is the case of a main road between Manchester and Liverpool. The cost of this road is estimated at around three millions, sterling. The Ministry of Transport has offered to find 50 per cent of the cost (this being considered a "first class" road) provided the Lancashire County Council and the thirteen County Borough Councils, through whose territory the road will pass, will find the other half.

The great difficulty here is that the rates of the districts would have to be increased over a period of thirty years to provide the interest and sinking fund for the one-and-a-half million, sterling. Another objection is that the government would save much of their half share by the reduction of the dole.

The position then is that it is almost impossible to get the local authorities to co-operate even though road construction is the most suitable type of work for all classes of unemployed. On the other hand, in the districts where the Manchester-Liverpool road has been planned, there are 120,000 able-bodied men drawing unemployment pay at the rate of three-and-a-half millions a year, plus one-and-a-half millions in what is called outdoor relief. In many cases, of course, men are offered work at wages slightly above the dole but prefer being paid at a lower rate for doing nothing.

It has also been suggested that the financing of these road schemes should be aided by a levy of 3d. a gallon on motor spirits. It is estimated that this would bring in an additional one hundred millions per year, which would go a very long way towards the reduction of local rates and make possible the construction of the many main highways of which Britain stands so urgently in need.

Quebec to Receive Bids for Des Quinze Power

In order to furnish a supply of electric power to the mining districts of Northern Ontario and the adjacent region in Quebec, the government of Quebec province will offer for sale by auction at Quebec City on April 25 a lease of the Des Quinze Rapids at the headwaters of the Des Quinze River. It is estimated that nearly 100,000 hp. could be developed. The lease will be offered at an upset price of an annual rental of $8,000 and the company obtaining the lease will be bound to develop at least 20,000 hp. in four years.

Students' Exhibit Shows Power Development

AN exhibit prepared by the students in water-power engineering of the State University of Iowa shows three types of water-power developments; low-head plant with reaction wheel (which can be seen through the glass front on penstock); the old overshot water-wheel (and grist mill) in the center (it is turning very rapidly in the picture) and the high head impulse wheel installed at the end of the steel penstock at the right. The railroad in the center is being run by power generated at the plant and passes through the city called "Gopher Prairie." Water from three sources supplies the projects which is returned to its source from the tailrace by a small centrifugal pump located underneath the exhibit. A transmission line of steel towers leading over the mountains can barely be seen.

Demand for Engineers Continues

Engineering services continue in demand with practically no unemployment in the ranks of professional engineers, according to the employment department of the American Association of Engineers. Probably a shortage will exist for both skilled and unskilled labor. It is already becoming noticeable in industrial establishments. Very few highway engineers of experience are available for employment and it will be necessary for the highway commissions to engage inexperienced men for their staffs or obtain young men who are being graduated this year from universities. The present heavy demand continues for designing engineers, in structural, mechanical and architectural lines. This holds true for practically all sections of the country except certain districts in the East. Boston reports that little outside engineering activity is in progress in the northeastern section, although most of the engineers are employed. New York reports considerable designing work now being undertaken with excellent prospect for construction work starting soon after April 1. Practically all other parts of the country report a shortage of professional engineers except a few sections west of the Mississippi River where the supply and demand about balance. The following table shows the trend of employment:

	February 1923	January 1923	February 1922
Applicants for employment	1,219	1,256	1,968
Positions received	526	537	312
Men referred	1,135	1,123	1,475
Men placed	115	149	172

The average salary of positions filled was $194 a month.

Standards Bureau Should Stress Scientific Research, Is View

"It is of the highest importance to the future of American industry and scientific progress that the activities of the Bureau of Standards should continue more and more devoted to scientific research of a profound and fundamental character, beyond the means of most college laboratories, where instruction to students is the chief purpose, and that these investigations shrould be of a broader scope than can be expected from research and testing laboratories in the service of special industries."

The foregoing is a portion of the findings of the Board of Visitors to the Bureau after a careful survey of the establishment's current activities. The Board of Visitors is composed of John R. Freeman, former president of the American Society of Civil Engineers; Ambrose Swasey, former president of the American Society of Mechanical Engineers; F. W. McNair, president, Michigan School of Mines; S. W. Stratton, president, Massachusetts Institute of Technology, and Wilder D. Bancroft, professor of chemistry, Cornell University.

"The determination of the physical constants of materials and the more thorough investigation of the properties of substance, apart from immediate applications seen in the industries," continues the report "seem particularly appropriate under the organic act creating this Bureau. We venture to suggest specific appropriations in the budget for such research."

War Department Grants Permission for Oakland Estuary Tube

Permission has been granted by the U. S. War Department for the construction of a tube passing under the estuary and connecting the cities of Oakland and Alameda, Calif. On receipt of this permission on April 2 the Board of Supervisors set May 8 as the date of a bond election to provide $4,496,000 for the construction of the tube.

The Oakland end of the tube will be at Sixth and Harrison Sts., and on the Alameda side at Webster and Work Sts. In the channel the tube is to be sunk deep enough to give a clear depth of 40 ft. at mean low water. The total length of the tube between portals will be 3,380 ft. and the maximum grade 4½ to 5 per cent according to final determinations. If the bonds carry, bids will be called for immediately and it is estimated that the work can be completed within two years.

Tentative plants prepared by George Posey, Alameda County engineer, provide for a tube with a 24-ft. vehicular roadway and two 3-ft. sidewalks. Pending the time that a separate tube is built for the electric railway, a double track line included within the 24-ft. roadway will be used. Preliminary studies indicate that the portion of the tube under the main channel might be made of precast concrete sections, 150 to 200 ft. long floated to place and sunk. Approaches to this section might be made in unwatered trenches.

The need for the tube is indicated by the rapid increase in traffic over the Webster St. bridge. In 1912 the maximum number of automobiles crossing this bridge in an hour was 67, in 1918 the number had increased to 444, and in 1922 it was 1,005.

The War Department has ordered that both the county bridge, which is also used by the electric railway, and the nearby Southern Pacific R.R. bridge, shall be removed by June 30 next. The penalty for non-removal by that date is set at $5,000 per month.

New York Building Congress Holds Annual Meeting

At the annual meeting of the New York Building Congress held in that city on April 17, the principal subject of discussion was the work of the apprenticeship commission conducted by the congress under the joint auspices of the employers and the trade unions of the building industry.

The commission reported that classes have been established for the carpentry and for the painting and decorating trades and that courses in the electrical trades will be opened in the immediate future. Additional building trades that now have the subject in hand for early action are the upholsterers, cement-masons, bricklayers, shop-draftsmen and cabinet-makers. Other trades will be asked to adopt similar programs and it is hoped that by the time the fall school session opens, all the building trades that need definite instruction will have fallen into line.

The commission reported also that apprenticeship instruction is either planned or already in operation in many other cities, including Boston, Philadelphia, Cleveland, Detroit, Seattle, Portland, Ore., and in the State of New Jersey. It paid tribute to the co-operation that has been extended to the work by the public school authorities, the trades unions and the employers.

The meeting was addressed by Eugene C. Gibney, of the New York City Board of Education; Peter J. Brady, chairman committee on education of the New York State Federation of Labor and Wm. J. Barney, of the New York Building Trades Employers Association, all of whom emphasized the importance of the work being done by the apprenticeship commission.

The congress elected as its officers for the ensuing year, Stephen F. Voorhees, president; Andrew J. Post, Alexander Kelso and William O. Ludlow, vice-presidents; Benjamin D. Traitel, treasurer and Richard A. Wolff, secretary.

Insurance Money Due Contractors Supreme Court Decides

Contractors engaged on construction work for the government during the war on a cost-plus basis are entitled to compensation for the premiums they paid for bonds and insurance, according to a recent decision of the U. S. Supreme Court, as the result of suits brought before the Court of Claims by the Mason & Hanger Co. and the Northeastern Construction Co.

The Supreme Court several months ago decided the cases this way, but the government obtained a rehearing. Several million dollars are said to be involved in several hundred cases of this character.

Am. Soc. C. E. Board of Direction Meets in New Orleans

(*Concluded from p. 723*)

The Sanitary Engineering Division of the Society was authorized to raise a fund of $1,500 to be used as a prize for the best paper presented to the Division. Petitions of Syracuse and Milwaukee for local sections of the Society were granted.

Two grants were accepted by the Board from Engineering Foundation. The first of these is for $1,000 for the proposed committee on Investigation of Concrete and Reinforced Concrete Arches, and the other of $1,000 this year and $2,000 for each of the next two years for the Committee on Investigation of Steel Columns. Engineering Foundation also offered to finance these committees further.

Arrangements are being completed at the session at New Orleans for the October meeting of the Society which is to be held at Richmond, Va., with side trips to Norfolk and Washington. Detroit and Salt Lake are endeavoring to secure one of the 1924 meetings.

Both the secretary and treasurer of the Society were unanimously re-elected.

The Board of Direction had an interesting trip to New Orleans. The New York delegation picked other members along the route. The Board was entertained by engineers at Cincinnati, Nashville and Birmingham and by chambers of commerce at Mt. Pleasant, Florence and Sheffield, Ala., near Muscle Shoals, where the Wilson dam was inspected and the party entertained at luncheon by engineer officers in charge at the dam.

Contractors Liable for Delay of Penalty Clause Work

Contractors on construction work for the Government where the contracts include a penalty clause for delay are not excused from paying the penalty even though additional delay in completing the project may be caused by the Government itself, according to a recent decision rendered by the Supreme Court.

The case was a suit instituted by Roy H. Robinson, administrator of the estate of John C. Robinson, versus the United States. Robinson in 1905 had a contract to install the interior finishing of the New York Customs House. By a supplemental contract the price was increased and the time extended. The work was not completed for 121 days after the date named. The Government insisted only twelve days' delay were chargeable to it and that the contractor was liable for $420 for each of the remaining 109 days delay. It, therefore, deducted $45,780 from the amount otherwise payable. The contractor brought suit to recover that sum and contended that since the Government had caused some of the delay the provision for liquidated damages became wholly inapplicable and was unenforceable and that since the Government had failed to prove actual damages it was not entitled to any damages.

The Court of Claims found that of the 121 days, only 61 were chargeable to the contractor and that the remainder were caused by the Government after the date of the supplemental contract. That court gave a judgment of $20,160 on this point. The administrator appealed.

Detroit Votes $17,000,000 for Power, Light and Railways

At a popular election held in Detroit on April 2, $12,000,000 of bonds were authorized for a municipal power and lighting plant and $5,000,000 for street railway extensions and improvements. It is expected that about 80 per cent of the output of the power and lighting plant will be used for the municipal railway system. The power and light plant bonds received 63 per cent and the street railway extension and improvement bonds 61 per cent of the votes cast, against the legal requirement of 60 per cent. The railway extension and improvements bond had been voted upon at two previous elections and apparently had failed to carry.

Interior Department Engineers to Complete Colorado Survey

A party of ten men, including two topographic engineers, one hydraulic engineer, and one geologist, from the Department of the Interior, will make a survey this summer of the deep and narrow gorges of the Marble and Grand Canyons of the Colorado River. The party will also make detailed examinations of all the possible dam sites. The survey of this 300-mile section of the Colorado River will provide the last section in the complete river map of the 1,200 miles from Green River, Wyoming, on the Green River and from Grand Junction, Colorado, on the Colorado River, to the Mexican boundary.

Nickel-Plate to Spend $3,670,000 on Improvements

The improvement program of the New York, Chicago & St. Louis Ry. calls for a total of $3,669,646, distributed as follows, and it is stated officially that it is expected all these expenditures will be made this year:

Additional second main tracks, 39 72 miles	$1,218,580
Additional yard tracks or sidings, 11 31 miles	307,805
Improvements to shops and engine houses	242,162
Straightening and extending bridges for heavier equipment and second track	452,026
Improvements to water stations	21,120
Improvements to coaling stations	75,100
Additional coaling station	15,000
Heavier rail and other track material	389,872
Improving signals and interlocking	24,761
Additional signals and interlocking	127,191
Improving telegraph and telephone lines, 6 5 miles	13,572
Elimination of grade crossings	782,457

Delaware & Hudson Centennial

The Delaware & Hudson Co. will celebrate the centennial of the granting of its charter with a dinner at the Hotel Astor, New York City, on Monday evening, April 23. At the close of the dinner a special train will leave for Wilkes-Barre, Pa., where on Tuesday forenoon the guests will visit a modern coal breaker in operation. At noon on Tuesday the company will give a luncheon at the Hotel Casey in Scranton. After the luncheon the special train will proceed to Carbondale, where was mined the first coal brought by the company to New York City, and thence over the Honesdale branch to see the place where, some years after its organization, the company tested its first steam locomotive.

Frisco Line to Spend $3,237,000

The addition and betterment program of the St. Louis-San Francisco Ry. for 1923 amounts to $3,237,000, exclusive of equipment. This program includes the following items: (1) second track from Valley Park to Eureka, Mo., giving 34 miles of double track out of St. Louis, $987,000; (2) an entirely new mechanical layout at Lindenwood (St. Louis), $800,000; (3) a similar installation at East Thomas (Birmingham, Ala.), $750,000; (4) machinery for these two plants, $200,000; (5) new machinery for various shops and roundhouses, $400,000; (6) grade revision at Dixon, Mo., $100,000. The contract for item No. 1 has been awarded to Grant, Smith & Co., and that for No. 6 has been divided between E. P. White, Kansas City, and John R. Scott, St. Louis.

Canadian National to Provide Own Insurance

President Sir Henry Thornton, of the Canadian National Railways has decided that hereafter the system, including the Canadian Government Marine, will provide its own insurance. It is officially estimated that this will effect a saving over a period of ten years of $1,000,000 annually. The National System has been carrying insurance aggregating upward of $400,000,000 representing an annual premium of about $4,000,000 and the profits to the insurance companies have been nearly 30 per cent. Instead of insuring with the companies a cash reserve will be established to take care of all the properties of the system.

Huge Steel Arch Bridge Proposed

In a call just issued for new proposals for the Sydney Harbor bridge at Sydney, N. S. W., Australia, the 1,600-ft. cantilever on which bids were asked a year ago is retained as the main project. Alternative bids, however, are asked on an arch span of 1,650 ft. center to center of bearings. This would far exceed any existing steel arch; the largest now in existence are the 840-ft. upper arch at Niagara Falls, N. Y., and the 1,000-ft. Hell Gate arch at New York.

Bids on the Sydney Harbor bridge are to be canvassed Nov. 30, 1923.

Cooper to Develop Cotter Site on White River

Full development of the Cotter site on the White River is to be undertaken by a company being organized by Hugh L. Cooper. The interests of the Dixie Power Company in this project already have been taken over by Col. Cooper.

The project contemplates the erection of a dam 215 ft. high. An extensive pool will be created which will reach up the river as far as Foresyth, Mo. Sites also are to be developed on the North Fork and the Buffalo Fork of the White River. The total development will create 125,000 hp.

Calendar

Annual Meetings

NATIONAL CONFERENCE ON CITY PLANNING, New York; Fifteenth Conference, Baltimore, April 30-May 2.

AMERICAN ASSOCIATION OF ENGINEERS, Chicago; Annual Convention, Norfolk, Va., May 7-9.

NATIONAL FIRE PROTECTION ASSOCIATION; Boston; Annual Meeting, Chicago, May 8-10.

NATIONAL HIGHWAY TRAFFIC ASSOCIATION, New York; Annual Meeting, New York, May 10.

AMERICAN ROAD BUILDERS ASSOCIATION, New York; Annual Meeting, New York, May 15.

AMERICAN WATER WORKS ASSOCIATION, New York City; Annual Convention, Detroit, Mich., May 21-25.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION; Annual Convention, Ithaca, N. Y., June 23-25.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia; Annual Meeting, Atlantic City, N. J., June 25-29 or 30.

The Rhode Island Section of the American Society of Civil Engineers will hold a joint meeting with the Municipal Section of the Providence Engineering Society, April 24. Robert Whitten, city planning consultant, will be the chief speaker.

The Dallas (Texas) Branch, American Society of Civil Engineers will hold a meeting April 22-23 at which John H. Dunlap, national secretary of the society will be present.

The Corporation of Professional Engineers of the Province of Quebec held its annual meeting last week and elected the following officers: President, E. R. Decary, Quebec, superintendent for the Province of Quebec of the Department of Public Works of Canada; vice-president, K. B. Thornton, E.E., Montreal; secretary-treasurer, Fred B. Brown, of W. J. Francis & Co., Montreal.

The Western Society of Engineers has started a movement looking toward the creation of a waterway terminal commission to be composed of engineers and be supported by an appropriation of $100,000. Resolutions memorializing the State Legislature to pass such a bill, initiated by L. K. Sherman, chairman of the sub-committee of the public affairs committee, have been passed by the board of directors and will be used in conjunction with similar resolutions from other civic organizations in presenting the matter to the legislators.

A Milwaukee Section of the American Society of Civil Engineers has been organized with J. C. Pinney, as president and A. L. Kurtz, Milwaukee Sewerage Commission, as secretary. At the second meeting April 10 a constitution was adopted to be forwarded to the board of directors for approval. Charles F. Loweth, president of the parent society, George H. Fenkell, director, and W. W. DeBerard, western editor of *Engineering News-Record*, addressed the meeting at which 30 were present.

Personal Notes

JOHN W. STORRS, consulting engineer, Concord, N. H., has been reappointed by Governor Fred H. Brown a member of the Public Service Commission of the state. Mr. Storrs has been connected with the New Hampshire Public Service Commission since its creation in 1911, serving as its chief engineer from that year until 1918 when he was named a member of the board.

MICHAEL J. RUTLEDGE, associated for the past three years in hydro-electric work with Henry Holgate, consulting engineer of Montreal, has been appointed town manager of Woodstock, N. B. He is a graduate of the University of New Brunswick, and also holds a degree from the University of Manitoba. Mr. Rutledge has had a wide experience in engineering work, including municipal engineering and executive work.

JOHN F. STEVENS has returned to the United States after nearly six years spent in assisting in the operation and improvement of the Railways of Russia, Siberia, and Manchuria. From March, 1919, until that body went out of existence in October, 1922, Mr. Stevens served as president of the Interallied Technical Board at Harbin. The Secretary of State has taken the occasion of Mr. Stevens' return as a fitting opportunity to thank him publicly for his services in behalf of the people of Eastern Siberia and Manchuria, and in advancing the prestige of the United States in that part of the world.

CHARLES C. CARLISLE, consulting engineer of Cheyenne, Wyoming, whose specialty has been water-works, sewer systems and power plants, was appointed city engineer of Cheyenne, March 28. Mr. Carlisle is a graduate of Washington State College. He began his engineering career in Wyoming in 1902, serving one year with the U. S. Department of Agriculture, and

the U. S. Department of the Interior. Later he served as deputy state engineer for five years, and in 1907 designed and directed construction on the Cheyenne million dollar water system. He opened his office as consulting engineer in 1911. Among the towns he has served are Douglas, Glenrock, Mannville, Casper, Thermopolis, Riverton, Hudson, Lander, Wheatland, Laramie, Rock River, Medicine Bow, Burns, Granger and Baggs, all of Wyoming, and Potter, Nebraska. In 1912 he was appointed receiver of the North Platte Valley Irrigation Co. Since its organization Mr. Carlisle has been a member of the Wyoming Engineering Society.

G. H. WILSEY, for the past five years structural engineer of the St. Paul Union Depot Co., has been appointed principal assistant engineer, in charge of design and construction of the new passenger terminal, under the direction of W. C. ARMSTRONG, chief engineer. W. B. MAY has been appointed assistant engineer in charge of construction, under the direction of the principal assistant engineer.

C. ARTHUR POOLE, city engineer of Rochester, has appointed JOHN A. O'CONNER of Albany, N. Y., to take charge of subway railroad work, to succeed the late LE GRAND BROWN. Mr. O'Conner has for the past 20 years been associated with the state engineer's office in Albany.

C. D. KING, of New Orleans, has been placed in charge of the maintenance of roads in the district comprising the parishes of Ouachita, Union, Caldwell, Jackson, Claiborne, Lincoln and Bienville, by the state highway commission of Louisiana. He will have headquarters at Monroe, La. These parishes have about 175 miles of roadway.

CHARLES F. ATKINSON has been appointed division engineer for the recently created State Highway Commission at Monroe, La. He will have charge of all construction work in Louisiana, north of Alexandria.

CHARLES A. POHL of New York City, chief engineer of the Niagara Gorge Ry. Co. and engineer for Anthony N. Brady water-power interests, has been appointed by the Watertown City Commission as consulting engineer on electrical equipment for the city's municipal power development at Delano Island. WILLIAM H. CUSHMAN is consulting engineer on hydraulic and constructional features.

C. G. WIGLEY, formerly chief engineer, State Department of Health of New Jersey, has been retained by the Atlantic City Sewerage Co. to investigate and report upon the necessary improvements to the sewer system and sewage treatment.

R. W. REA, who for the past sixteen months has been making engineering investigations and reports for the Bond House of Ralph Schneeloch Co. of this city, has just opened an office as consulting civil and hydraulic engineer at 221 Lumbermens Bldg, Portland, Ore.

MAJOR WILLIAM G. SLOAN, of Nutley, has been named state highway engineer of New Jersey by the new New Jersey State Highway Commission for a term of four years. Major Sloan will take up the duties of Thomas J. Wasser, former state highway engineer, who resigned after the old board had been discharged. Mr. Sloan has had a varied experience in the field of engineering. In 1900 he started as assistant engineer of the Illinois Central R.R. Co. After two years' service with the railroad he went with James Stewart & Co. and while in its employ he had charge of foundations and masonry for the plant of the British Westinghouse Electric & Manufacturing Co., at Manchester, England. During the latter part of 1903, Major Sloan was engaged as chief engineer by MacArthur Brothers Co., a nation-wide contracting concern. Within a year he became vice-president of the company and carried on large contracts in this and foreign countries. In February, 1918, he was given the rank of major of Engineers, later taking the Twenty-second Regiment of Engineers to France. This regiment took charge of light railway construction. Major Sloan is 48 years old. Edward H. Reed will continue as assistant state highway engineer.

C. J. HOWARD has resigned as city engineer of Corpus Christi, Texas, to become associated with E. E. Sands, consulting engineer, Houston, Texas.

L. D. SNOW, recently engineer for the Mexican Gulf Oil Co. in Tampico, Mexico, has been appointed chief engineer of the South American Gulf Co. with headquarters in Venezuela. Mr. Snow is a graduate of the engineering college of the University of Texas and has had much experience as an irrigation engineer in the Rio Grande Valley. Later he was a first lieutenant of engineers, U. S. A., and after the war was on the Texas State Board of Water Engineers.

J. M. DAWSON has been appointed geologist for the South American Gulf Co. in Venezuela. He was recently with the Gulf Production Co. at San Antonio, Texas. Mr. Dawson is a graduate of the University of Texas and served as a captain in the army.

WILLIAM M. ROBINSON, JR., recently employed as special engineer of valuation for the Georgia and the Atlanta and West Point Railroads, has entered the general practice of civil engineering, including the making of valuations, appraisals and special reports. His offices are in the Marion Building, Augusta, Ga.

J. B. CAMERON, of the Ulen Contracting Corp., now doing considerable construction work in South America, has been appointed chief engineer of construction of the Atocha-Villazon R.R., a line connecting Argentine and Bolivia. Upon completion of this link railroad travel will be possible from Buenos Aires to Peru.

D. S. FOWLER, formerly assistant engineer of the Illinois Highway Commission, has become associated with E. B. PARSONS, Jefferson, Wisconsin, in the practice of civil and municipal engineering. Mr. Fowler will open an office at Watertown, Wisconsin.

Dr. CARY T. HUTCHINSON has become associated with Sanderson & Porter, engineers, New York City, as director of their department of railroad electrification. Dr. Hutchinson has been handling railroad electrification problems for many years, having been long identified with the firm of Sprague, Duncan & Hutchinson, later Duncan & Hutchinson, consulting engineers. Sanderson & Porter have but recently decided to extend their engineering construction and management work for public utilities to include railroad electrification. The appointment of Dr. Hutchinson is the result of this desire to broaden their engineering service.

WALTER J. DODGE, assistant engineer for the California State Railroad Commission's gas and electric department for the past five years, has been appointed telephone and telegraph engineer of the commission.

JOHN CORRIGAN, a building contractor of Phoenix, Ariz., has been appointed by Governor Hunt as a member of the board of regents of the University of Arizona.

J. P. TUPLIN, who was for a number of years on the engineering staff of the Foundation Co. and more recently with George B. Post & Sons, both of New York, is now structural engineer for the W. S. Barstow Management Association of New York with headquarters in Reading, Pennsylvania.

U. STEPHENS, formerly county engineer of Runnells County, at Ballinger, Texas, becomes resident consulting engineer for the Terrell Bartlett Engineers, Calcasieu Bldg., San Antonio, Texas, at Beaumont, Texas, in connection with dock and municipal improvements.

Obituary

COL. JOSEPH W. BOYLE, American mining engineer, well known in railroad engineering circles, died in London, April 14, according to cable advices. Col. Boyle was instrumental in organizing the first Canadian pioneer railway troops during the World War. In 1917 he was sent to Russia to aid that country in transportation reorganization. He had made his home in Woodstock, Ont.

S. HOWE BONAR, city engineer of Moundsville, W. Va., died in that city recently, aged 55 years. He had been city engineer for a number of years, having previously served the county in which Moundsville is located as engineer.

GEORGE W. KINNE, formerly erecting engineer for the American Bridge Co., died recently at his home in Elmira Heights, N. Y. Mr. Kinne was a graduate of the Rensselaer Polytechnic Institute and saw service in both the Spanish-American War and in the World War.

JOHN E. BENNETT, for more than forty years one of the leading building contractors of Portland, Ore., died recently in that city, aged 75 years. He was born in Toronto, Canada, but moved to the coast in 1881 and had made his home in Portland since that time.

WALTER H. RENTON of the cement contracting firm of Hinchman and Renton, Denver, Colo., died recently, aged 67. Mr. Renton has been in the contracting business in Denver for thirty years. He was a native of England.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

Part Played by Good Paint in Equipment Maintenance

Life of Construction Machinery May Be Lengthened by Protecting Metal from Rust

By Roy C. Sheeler

Paint and Varnish Division, E. I. du Pont de Nemours & Co., Inc., Philadelphia

DURING the past few years tremendous strides have been made in the development of labor-saving machinery for construction work. Nowadays, even in the construction of massive buildings and enormous development projects, there is comparatively little laborious muscular work done. Machinery has taken the place of hand labor. This has meant the emancipation of the laboring man, and has been the means of the great speeding-up that is possible in all construction work.

The care given to this machinery, most of which is high in cost, is apparently not seriously considered by many contractors. All units are attractively finished when purchased, but in some instances, at least, the paint that is applied is not of the proper character to resist for any length of time the severe conditions under which the equipment is used. While rust and corrosion of all metal surfaces is unremitting in action, the deterioration of construction machinery is particularly rapid. This is due to the unusually severe treatment accorded most of this sort of equipment. It must withstand actual abuse in many instances, due to no particular fault in its operation, but to the kind of service it must give. As a consequence, rapid depreciation of much of such equipment is inevitable.

Painting Neglected

In comparatively few cases does any of this machinery receive a coat of paint after purchase. It continues in action until repairs are necessary, in which case certain repair parts may or may not receive paint protection. Where paint is used, it is often unsuited for the work it is called upon to do. Consequently, its life is comparatively short.

In painting steel surfaces the use to which the equipment is put should be borne in mind. Obviously, it is too much to expect any paint to bear up under constant contact with sand, gravel, cinders and other substances having high abrasive action. One might as well save his energy and the cost of paint and painting, as to paint the inside of steel dump bodies of trucks, the interior of crane buckets, or other equipment of like nature. But the *outside* of such apparatus should not be neglected, as it is generally subject to less severe treatment than the interior surfaces. Rust begins with an abrasion of the paint coat, and unless checked, it is likely to spread until the paint coat is of practically no value as a protective medium.

For repainting machinery and construction equipment, it should be borne in mind that the paint should be a rust-inhibitor and not a stimulator. Such paints as those composed of graphite, carbon, lamp-black, etc., are all right, provided they do not come in direct contact with the metal surface. But if rust spots are present and such a finishing paint is used, it will invariably *stimulate* additional corrosion at such points, rather than prevent it.

Two Classes of Paint

There are two classes of paint that are suitable for repainting—one composed of oxides of iron or other stable pigment, ground in linseed oil, and the other a combination of known rust-inhibiting pigments mixed with a durable, elastic varnish vehicle. Either of these classes will give good service. Under normal conditions of use—that is where the surface is not subject to extremes of moisture or contact with acid or gaseous fumes—the first-named composition will give maximum protection. But where conditions of use are particularly severe, the latter mixture is preferred. It will be found to offer greater resistance to corrosion, and the rust-inhibiting qualities of such a paint makes it particularly valuable for use on bare spots as well as on previously finished surfaces.

Pointers on Paint

- *Any paint is not suitable for all purposes*
- *Rust begins with abrasion of the paint coat*
- *Paint for construction equipment should be a rust-inhibitor*
- *Preparation of clean, dry, surface is important*
- *Painting is cheaper than replacement of machinery*

The proper preparation of the surface for repainting is of utmost importance. No matter how good the paint may be, unless the surface is in right condition for painting, unsatisfactory results are sure to follow. The surface should first be clean and free from dust and dirt. All rust spots should be wire-brushed or chiseled out and carefully dusted. Do not attempt to paint over rust and expect the paint to do its duty. The rust will go on just the same—often proceeding under the paint until the surface is practically destroyed. Paint should never be applied over damp surfaces. The heat of the sun will withdraw the moisture and cause blistering and peeling of the paint.

Since construction machinery today is usually built of steel, the suitability of the paint for such surfaces is one of the most important considerations. In the main, however, if a paint is purchased for use on steel, it will give equally good service on such parts of the equipment as are made of wood. The same general directions for the preparation of the wood surface should be observed. In the case of machinery subject to high temperatures, like the boilers of steam cranes or shovels, air-compressing machinery, etc., the paint should be able to withstand such conditions. In most instances, such surfaces should be painted with a locomotive black, made for this purpose.

If contractors would bear in mind the fact that painting is cheaper than replacement, and that the money invested in paint and painting is not an expense, but an actual saving, they could do a great deal toward warding off the time when replacement of expensive equipment becomes absolutely necessary. Good paint, applied at frequent intervals will save the surface from decay and destruction. And when you "Save the Surface, You Save All."

National Association of Manufacturers to Hold Convention

The National Association of Manufacturers will hold its twenty-eighth annual convention at the Waldorf-Astoria Hotel, New York, May 14-16. The program will include discussion of such subjects as transportation, construction, production, the open shop, immigration, and taxation.

Koppel Co. Wins Court Appeal

By a decision of the U. S. Circuit Court of Appeals for the Second Circuit, rendered March 14, the Koppel Industrial Car & Equipment Co., Koppel, Pa., is sustained in its complaint against Orenstein & Koppel Aktiengesellschaft, Orenstein & Koppel Co., Ltd., L. E. Hellman and Eric Joseph. The case involves the sales activities in the United States of the latter organizations and individuals following the sale, on Sept. 12, 1918, by the Alien Property Custodian, of the American business and good will, as a going concern, of the German corporation known as Orenstein & Koppel-Arthur Koppel A. G. The sum involved in the transaction was $1,312,000 and after a reorganization the name of the Koppel Industrial Car & Equipment Co. was adopted by the purchasers of the former business.

In 1920, however, the German corporation attempted to reorganize in the United States and recapture the business sold by the Alien Property Custodian. This action brought about the suit under discussion. The Court said: "To permit of the sale of the physical property only would have deprived the purchaser in the instant case of the great value of the good will of the German corporation which had made its business and its growth during the preceding years. . . . The sale was as complete as if it were a voluntary conveyance of its interests in the United States by the German corporation. We think this conveyed to the purchaser the exclusive right to carry on the business in the United States with the right of protection of a court of equity from interference by the German corporation, for if the present interference be permitted, what was conveyed would, in time, be destroyed. Assuming a voluntary sale of its good will and business had been made by the German corporation, would it have been at liberty later to impair the good will by seeking the customers of the buyer and carrying on business using substantially the same trade name and trade symbol as they had heretofore used? We think not."

Featuring of Record Runs Elicits Further Comment

Supplementing the discussion in last week's issue (p. 688) other equipment manufacturers this week state the policies of their organizations.—EDITOR.

By H. S. STROUSE
Advertising Manager,
Pawling & Harnischfeger Co., Milwaukee

WE HAVE never found it desirable to feature record runs. It is difficult to obtain such figures with excavating machinery because every job is performed under different circumstances, and figures which would be applicable on one job would certainly not apply on another. Even where we do have records of contractors who have made unusual amounts of yardage in single shifts, we never publish them because unusual records are discredited by those familiar with excavating.

We have adopted the policy of mentioning only conservative records, for we believe it distinctly bad form to lead the uninitiated into believing in miracles. In one instance during the past year we did mention in our advertising a very unusual stunt that was performed with one of our trenching machines, but this was mentioned more from an engineering point of view than anything else. Any campaign for omitting extravagant statements from advertising of contractor's equipment, will have our hearty support, for we believe that even though exaggerated statements may be nearly true, they have a bad effect.

By JOHN H. GREGORY
Publicity Manager,
Barber-Greene Co., Aurora, Ill.

HIGHWAY construction averages have been increasing yearly. The maximum run of a few years ago is now practically the average run. Sometimes a maximum run means that the contractor has slackened off his regular work for several days in preparation for the big run. Sometimes it means that the job is carried on as usual but that positively everything on the job functions at its best for 10 hours. In either case the records do not mean anything unless accompanied by the general average for the season.

Our policy in advertising or publicity is to base our statements on general averages taken over long periods but at the same time we are not averse to telling that our machines were able to handle all the material for a record run. Unless every condition is given, general averages can be as deceiving as record runs. We believe in giving all data possible in either case.

(To Be Continued Next Week)

New Caution Plate Adopted by Motor Truck Makers

At the Motor Truck Conference held at the headquarters of the National Automobile Chamber of Commerce in New York City recently a new caution plate was adopted as standard. It is an outgrowth of a demand by motor vehicle commissioners for information on which to rate trucks and represents the result of joint action by subcommittees of the Society of Automotive Engineers, the Truck Standards Committee of the National Automobile Chamber of Commerce, and the motor vehicle commissioners of all of the New England States, New York, New Jersey, Pennsylvania, and Maryland. The new plates are 10½ in. long, 3¼ in. wide. The information carried by the plates is indicated in the accompanying sample.

Speed ratings also were standardized by the committee and range from 15 miles per hour for a truck of gross weight of 28,000 lb. to 25 miles per hour for a 4,000-lb. gross weight, both on solid rubber tires. For pneumatic tires a maximum speed of 25 miles per hour is allowed for gross weights up to 28,000 lb.

Body-weight allowances were adopted as follows: 1,200 lb. for a 1- 1½-ton truck; 1,500 lb. for a 2- 2½-ton truck; 2,000 lb. for a 3-4-ton truck; 2,500 lb. for a 5-ton truck.

Standard frame widths of either 36 or 42 in. for all sizes of commercial vehicles were indorsed.

Maximum speed 16 miles per hour. Do not exceed. This vehicle, when tested at the factory, showed a brake capacity which enabled the driver to stop it, when loaded to its stated capacity and when running at its maximum stated speed in 40 feet on a dry, hard level road. NOTE: Chassis weight includes complete chassis, front fenders, step, driver's seat, tools, lamps, horn, license brackets, normal quantity of fuel, lubricant and cooling medium; but without driver, body, auxiliary power devices or equipment.

Name and Address of Manufacturer Made in U.S.A.

Chassis Number

Caution Overloading or over speeding will void your warranty.

	Lbs.
Maximum weights	
Chassis (see note)	6,300
Body, load & equip.	8,000
Gross weight	14,300
Front axle (gross)	6,000
Rear axle (gross)	12,000

Business Notes

JOHN F. HAVEMYER, JR., has joined the sales force of the Concrete Steel Co., with headquarters in New York City.

ROBERT F. EISSLER, for two years assistant to the vice-president of the Chicago Pneumatic Tool Co., New York, at his own request assumed his former position as district manager at Pittsburgh, effective April 1. Nelson B. Gatch succeeds Mr. Eissler as assistant to the vice-president, with headquarters at New York. William C. Straub becomes district manager at New York, succeeding Mr. Gatch.

HARVEY B. CHESS, JR., president and treasurer of the Consolidated Expanded Metal Cos., Braddock, Pa., died March 30.

FRED S. MARTIN, for eleven years superintendent of the large industrial motor department, Westinghouse Electric & Manufacturing Co., died recently in Pittsburgh. He was 60 years old and before joining the Westinghouse organization served with the Franklin Foundry & Machine Co., Providence, R. I., the Brown & Sharp Manufacturing Co., Providence, R. I., the Edison General Electric Co., Schenectady, and the R. D. Nuttall Co., Pittsburgh.

ADVANCE MACHINERY & SUPPLY CO., Denver, Colo., announces the closing of a contract with the Board of Water Commissioners of the city and county of Denver for three De Laval centrifugal pumping units, two electrically driven and one steam-turbine driven. The daily capacities are, respectively, 4, 8 and 10 million gal.

H. E. MARKS CORP., Pittsburgh, manufacturer of gypsum roofs, announces the appointment of the American Hard Plaster Co., Utica, N. Y., as exclusive representative in Oneida and Herkimer counties.

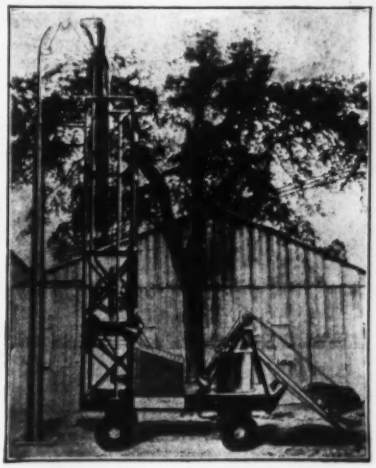
MONARCH TRACTORS, INC., Watertown, Wis., are working on a 24-hr. production schedule. Shifts have been arranged for continuous operation to meet orders on hand.

EDWARD C. WALDVOGEL, general manager, Yale & Towne Manufacturing Co., Stamford, Conn., was elected a vice-president of the corporation, at a meeting March 8 of the board of directors. His title in the future will be vice-president in charge of sales. Mr. Waldvogel has served for 18 years with the company.

Equipment and Materials

New Concrete Pole Machine

For casting concrete poles in place the Blaw-Knox Co., Pittsburgh, is placing on the market a pneumatic mixer rig planned to produce a pole following the same principles of economical design as are used in transmission towers and poles. The method employed, it is claimed, allows only the proper amount of steel to be used and the proper amount of concrete to give ample protection to the steel;—the extra reinforcement ordinarily required to make the pole act as a beam while being handled is eliminated.



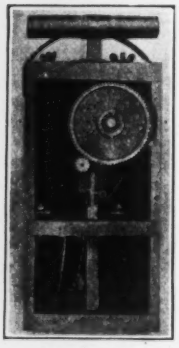
The rig is mounted either on a self-propelled or a trailer truck. The mixer is served by a power loader and is

operated by a gas engine geared to an air compressor. The arrangement is shown in the accompanying illustration. Concrete is discharged pneumatically from the mixer through a pipe to the top of the tower, whence it passes into a hose which loops around a movable sheave in the tower, thence up to the top head and down into the forms, terminating in a special nozzle which controls the discharge of concrete. When starting concreting this nozzle is at its lowest position, about at ground level, and the movable sheave is at its top position. As soon as discharge starts the movable sheave is power-driven downward, thus keeping the nozzle above the rising concrete. Concrete is discharged with enough force to produce is provided with an extension frame which may be raised or lowered for various heights of pole.

Forms and reinforcement can be erected either in advance of the machine or can be handled from a jib at the top of the tower. The rig can be knocked down and folded up for transport, the overall length in this condition being 25 ft. and the height 12 ft. Poles can be cast to any height up to 45 ft. Provision may be made in the forms for cross-arms, ladder rungs and any other special features.

An Improved Blasting Machine

Reserve capacity to guarantee against failure to fire any electric blasting cap in circuits up to 100 caps is provided in an improved blasting machine, developed during the war and now manufactured for commercial use by the Hercules Powder Co., Wilmington, Del. One of the principal advantages claimed for the new machine is in the generator, which is of a shunt-wound type instead of the series-wound type common in former machines. The new machine utilizes practically all of the energy of the operator during the downward stroke of the handle and the current it delivers into the cap circuit is sustained for a longer period than in the series-wound machine. The generator in the new type delivers 1½ amp. at 300 volts when connected to a circuit of 100 blasting caps in series.



Although the new machine has actually fired as many as 200 electric blasting caps, its capacity is rated at only 50 caps, for experience has shown that it is not advisable to connect more than this number in one series.

Wall-Board of Sugar Cane Wastes

Bagasse, or sugar-cane waste, is being manufactured into an insulating wall-board called Celotex by the Celotex Products Co., with headquarters at Minneapolis and plant at New Orleans. The product comes in sheets 0.4 in. thick, 4 ft. wide and from 8 to 12 ft. long. It weighs 60 lb. per 100 sq.ft. and can be sawed and applied like lumber directly as sheathing to roofs or as studding both inside and outside. The material is treated to resist the absorption of water.

Strength tests of the material conducted by Robert W. Hunt & Co. showed a favorable comparison with white pine timber. These tests included tensile, transverse and compressive strength, stiffness and nail holding properties.

Attachment Converts Farm Tractor Into Industrial Locomotive

An adaptation of the Fordson tractor to narrow-gage industrial railway haulage is made possible by an attachment manufactured by the Adamson Motor Co., Birmingham, Ala. It consists of a steel locomotive frame with cast-iron bumpers at front and rear, 9 ft. 10 in. in overall length, one-piece steel axles with Hyatt roller bearings, and flanged wheels 33 in. in diameter and with 4-in. treads built to the specifications of the American Railway Association. The wheel base is 74 in. and the gage may be from 36 to 56 in.

The attachment weighs 2½ tons and the locomotive, complete, 3½ tons. There are three speedsforward and one reverse. The brakes are of the automobile type, asbestos-lined and operated with a clutch pedal. On level track the manufacturer claims that the locomotive will haul a gross load of 65 tons in high gear, 70 tons in intermediate, and 158 tons in low gear. The tractor may be set into the locomotive attachment or changed back to its original form in about 3 hr. The Adamson company also manufactures a turntable to be installed at either end of a line of track to enable the tractor to operate on its forward speeds.

Steel Case Batteries Made in Two New Sizes

The National Carbon Co., Inc., Long Island City, N. Y. has announced two new types of Columbia "Hot Shot" batteries of the steel case construction, one of 5 cells in series arranged in two rows giving 7½ volts, and the other of 6 cells in series arranged in two rows giving 9 volts. These two new batteries have the same design and appearance as the Columbia 4-cell, 6-volt unit. With these new types of steel-case batteries it is now possible the company claims, to meet the requirements of practically every dry battery ignition system used on stationary gas engines, motor boats, tractors and construction equipment.

Publications from the Construction Industry

Hoisting Machinery—O. K. CLUTCH & MACHINERY CO., Columbia, Pa., has issued a 16-p. illustrated catalog of its single, double, and triple-drum reversible and non-reversible hoisting machines.

Tar and Asphalt Heaters—LITTLEFORD BROS., Cincinnati, have issued a 19-p. illustrated catalog of their tar and asphalt heaters, paving tools and equipment for contractors and municipalities. The capacity of the kettles range downward from 1,000 gal., for large jobs, 50 gal. for roofing and waterproofing work, and 10 gal. for a highway patrol heater. An oil-burning attachment, instead of a fire box for solid fuel, may be added to any of the company's road maintenance heaters.

Railroad Bridge Waterproofing—MINWAX CO., INC., New York, has issued an installation data folder describing the membrane waterproofing of bridge structures employed by the Chicago & Northwestern R.R. in its track elevation work.

Ventilating Fans—CLARAGE FAN CO., Kalamazoo, Mich., has published a 48-p. illustrated booklet on ventilation and the use of its multiblade fans in city schools, theatres, banks and other public and private buildings. The booklet cinsists largely of illustrations of buildings in which the company's ventilating equipment has been installed.

Colored Concrete—MASTER BUILDERS CO., Cleveland, in a new 12-p. illustrated section of its handbook, describes Colormix, an integral product for coloring, hardening and waterproofing concrete floors. The material is marketed as a paste of about the consistency of white lead, which is dissolved in the mixing water and dyes the sand and cement, thus producing a uniform color throughout the layer and not a thin veneer on top. Colored cement tile employing this new compound are made in regular sizes 6 x 6 in., 6 x 9 in., and 9 x 9 in., and larger. Colormix is supplied in six shades, tile red, linoleum brown, nile green, battleship gray, buff, and white. It is intended for decorative floors in stores, apartment houses, hospitals, schools, hotels, clubs, restaurants, and commercial and industrial buildings.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Bond Sales Gain in Number of Separate Issues

State and municipal bond sales during March totaled $62,038,909, a decrease of $15,370,088 from the February total of $77,408,997, with a still greater falling off as compared with $94,900,878 in January, according to the *Commercial and Financial Chronicle*.

There has been no falling off in the number of separate issues during the last month. The number of municipalities issuing permanent bonds and the number of separate issues during March were 371 and 510, respectively, compared with 471 and 588 for March, 1922.

Of the fifty-three representative issues listed in the accompanying table, seven sold at par, forty-three above and only three below par; the yields ranging from 4.15 to 6.64 per cent.

Rates varied from 4 to 6 per cent; the single 4 per cent issue being in South Carolina and the 6s in Florida, Indiana, California, Porto Rico, North Carolina and Ohio. The only issue drawing 4¼ per cent was sold in New York state, while the 5½s were disposed of in Texas, Ohio, Louisiana, Washington and Utah. Securities drawing 4½ and 5 per cent formed the bulk of the fifty-three disposals and were fairly well distributed throughout the country. The two 4¾s, however, were sold in Ohio and Kentucky.

New Jersey to Issue $8,000,000 Road Bonds This Year

The first step to carry out the provisions of New Jersey's $40,000,000 road bond issue was taken recently by the State Highway Commission when bonds to the extent of $8,000,000 were authorized for issuance. Under the terms of the act, the commission may use no more than $8,000,000 a year for five years. The plan, as outlined by the commission, provides that $4,000,000 be issued about June 20, bearing date as of July 1; $3,000,000 of this amount would be used for actual road construction and the other $1,000,000

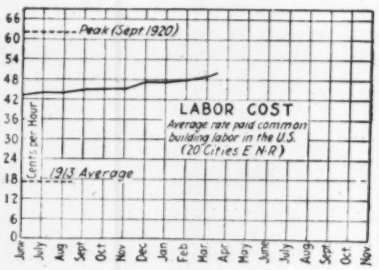
REPRESENTATIVE PUBLIC BOND SALES DURING APRIL, 1923

State	Purpose	Amount	Rate Per Cent	Sold For	Basis	Dated	Maturity	Purchased By
Indiana		$1,000,000	4½	97	....	March, 1923	.....	Northern Trust Co. of Chicago, and others.
County								
Athens, O.	Road improvement	53,000	5	100.508	4.73	Sept. 1, 1923	1924-33	Spitzer, Rorick & Co., Toledo
Brewster, Tex.	Road	300,000	5½	100.91	....	Mar. 29, 1923	.....	Hall & Hall of Temple, Tex.
Clackamas, Ore.	Road	246,070	5	100.41	4.72	Mar. 1, 1923	1937-41	Stacy & Braun and John E. Price & Co.
Clay Co. Road Dist., Tex.	Road	8,650	5½	100.	....	.....	.....	H. C. Burt & Co., Houston
Douglas, Neb.	Road	400,000	5	108.416	4.27	Oct. 1, 1919	1942-43	P. W. Chapman & Co., Inc., New York
Dubois, Ind.	Highway improvement	59,000	4½	100.	....	Apr. 10, 1923	1924	Dubois Co. State Bank
DuPage, Ill.	Road	600,000	4½	100.41	4.45	May 1, 1923	1924-43	Northern Trust Co., Chicago
Highland, O.	Road	56,000	5	100.468	4.90	Mar. 1, 1923	1924-31	N. S. Hill & Co., Cincinnati
Highlands, Fla.	Road	525,000	6	101.87	5.82	.....	1924-53	Spitzer, Rorick & Co., Toledo
Holmes, O.	Road	16,650	5½	100.779	5.33	Apr. 1, 1923	1928	Commercial and Savings Bank, Millersburg
Huron, O.	Road	8,500	5	100.06	4.99	Apr. 1, 1923	1924-32	Tucker and Robison, Toledo
Middlesex, N. J.	Road improvement	239,000	4½	101.433	4.33	Mar. 29, 1923	1925-45	Vanderhoef & Robinson, New York
	General improvement	45,000	4½	100.124	4.47			
	Bridge	42,000	4½	101.392	4.35			
Montgomery, O.	Bridge	9,000	5½	101.868	5.07	Apr. 1, 1923	1924-32	N. S. Hill & Co., Cincinnati
Pitt, N. C.	Bridge	100,000	5	102.10	....	Apr. 1, 1923	1928	Title Guarantee & Trust Co., Cincinnati
Pulaski, Ind.	Ditch	6,440	6	100.	....	Mar. 15, 1923	1924-33	Breed, Elliott & Harrison, Indianapolis
Redwood, Minn.	Drainage	195,000	4½	100.11	4.49	Apr. 1, 1923	1929-43	Minnesota Loan and Trust Co. Minneapolis
Rush, Ind.	Road	33,982	5	101.622	4.69	Apr. 1, 1923	1924-33	Rushville Nat. Bank, Rushville
San Joaquin, Calif.	Reclamation	105,000	6	93.	6.64	Mar. 1, 1923	1939-43	Hunter-Dulin Co., San Francisco
Sevier, Utah	Road	120,000	5	102.50	....	.....	1934-43	Ashton Jenkins, Salt Lake City
Smith, Tex.	Road improvement	90,000	5	102.013	....	.....	.....	Sidney Spitzer & Co., Toledo
Surry, N. C.	Road	150,000	5	102.64	....	.....	.....	Sidney Spitzer & Co., Toledo
Vanderburgh, Ind.	Road	22,200	4½	100.	....	.....	1924-33	Oliver Edmond of Evansville
Washington, O.	Road	77,000	5½	101.47	5.19	Mar. 1, 1923	1924-33	W. L. Slayton & Co., Toledo
Township								
Huntington Beach School Dist., Orange Co., Calif.	School	250,000	5	102.31	....	.....	.....	Security Trust & Savings Bank of Los Angeles.
Municipality								
Ashland, Ky.	Sewer	80,000	5	101.832	4.43	Apr. 2, 1923	1932-37	Keane, Higbie & Co., New York
		120,000	4¾				1942-52	
Bexley, O.	Street improvement	162,540	5½	101.27	....	Apr. 1, 1923	1924-32	Ryan, Bowman & Co., Toledo
Charleston, S. C.	Sewer	500,000	4	91.94	4.62	Mar. 1, 1923	1963	Peoples National Bank, Charleston
East Cleveland, O.	Street improvement	175,000	5	101.62	4.74	Apr. 1, 1923	1924-36	Guardian Savings and Trust Co., Cleveland
East Providence, R. I.	Highway	105,000	4½	100.364	4.43	May 1, 1923	1924-33	R. I. Hospital Trust Co., Providence
Franklin, Tenn.	Water-works extension	25,000	5	101.32	4.76	Apr. 1, 1923	1928-32	Williamson Co. Banking & Trust Co., Franklin
Garfield, N. J.	Water	131,000	5	100.	....	Jan. 1, 1923	1924-29	R. M. Grant & Co., Inc., New York
Glastonbury, Conn.	School	175,000	4½	103.265	4.23	Jan. 1, 1923	1924-58	R. M. Grant & Co., Inc., New York
Hagerstown, Md.	Sewerage system Disposal plant	450,000	4½	103.316	4.34	Apr. 1, 1923	1964-86	Stein Bros. & Boyce and others
Lajas, Porto Rico	City improvement	116,000	6	109.	5.11	Jan. 1, 1923	1928-51	Provident Savings Bank, Cincinnati
Leavenworth, Kan.	Street improvement	110,000	5	100.125	....	Dec. 1, 1922	1924-33	Brown-Crummer Co., Wichita
Madison, Wis.	Sewerage	200,000	4½	100.86	....	Mar. 23, 1923	.....	A. G. Becker & Co., Chicago
Madisonville, La.	Public improvement	25,000	5½	100.	....	Mar. 1, 1923	1924-43	Covington Bank & Trust Co.
Maiden, N. C.	Street improvement	25,000	6	103.50	5.43	Jan. 1, 1923	1925-37	Geo. McCorkle and Dr. Sterling Ruffin Washington, N. C.
Marshville, N. C.	Water Sewer	75,000	6	104.56	5.56	Apr. 1, 1923	1926-63	Prudden & Co., Toledo
Massillon, O.	Paving	39,482	5	100.869	4.83	Apr. 1, 1923	1924-32	Guardian Savings and Trust Co., Cleveland.
Mayfield, N. Y.	Pumping system	50,000	5	100.15	4.98	Jan. 4, 1923	1927-51	Sherwood & Merrifield, New York
Muskegon, Mich.	Storm sewer	35,000	4½	101.042	....	Mar. 26, 1923	1940-45	Bolger, Mosser and Willaman, Chicago
Newark, N. J.	Public improvement	685,000	4½	102.261	4.30	Apr. 2, 1923	1924-52	West Side Trust Co., Newark
	Sewer	632,000	4½	102.924	4.29	Apr. 2, 1923	1924-63	
	School	985,000	4½	101.534	4.32	Apr. 2, 1923	1924-43	
	Fire apparatus	50,000	4½	100.222	4.42	Apr. 2, 1923	1924-28	
Norwalk, O.	Street improvement	53,720	5	100.	....	June 1, 1923	1924-31	H. B. Bennett, Toledo
Painesville, O.	Paving	221,000	5	100.38	4.91	Apr. 1, 1922	1924-32	Harris, Forbes & Co., of New York and others
Rockford, O.	Water-works	8,500	6	101.59	5.62	Jan. 1, 1923	1924-32	Spitzer, Rorick & Co., Toledo
Sandusky, O.	Street improvement	112,700	5	100.828	4.84	Mar. 1, 1923	1925-33	Spitzer, Rorick & Co., Toledo
Saratoga Springs, N. Y.	Park	50,000	4¼	101.19	4.15	Mar. 1, 1923	1942-44	Sherwood and Merrifield, New York
	Water-works	21,000					1931-41	
	Public improvement	14,000					1931-37	
	Bridge	36,000					1931-42	
Seattle, Wash.	Light and power system	2,520,000	5½	103.30	5.15	May 1, 1923	1929-43	R. M. Grant & Co., Inc., New York
Sierra Madre, Calif.	Park	30,000	6	103.36	....	Mar. 1, 1923	1963	Hunter, Dulin & Co., Pasadena
Springville, Utah	Water	140,000	5½	100.10	....	.....	1943-53	Hanchett Bond Co., Chicago
Toledo, O.	Bridge repair	52,000	4½	100.64	4.44	Jan. 15, 1923	1925-47	Otis & Co., of Cleveland and others
	Public building	418,000	4½			Mar. 1, 1923	1924-44	
	Sewer	700,000	4½			Jan. 16, 1923	1925-47	

would be reserved for bridge work. The commission would issue a similar amount of bonds next December. The law places a maximum of 30 years for the bonds on road and 15 years for bridge bonds. The money derived from the bonds need not actually be expended during the calendar year for which it is certified.

Common Labor Wage Rate Higher

The wage rate for common labor in the construction industry has returned to the level prevailing in 1920 and the first quarter of 1921, in the New York district. Union building laborers now receive 75c. per hr. for an eight-hour day, as against 60c. in the spring of 1921.



LABOR WAGE RATE CURVE, 1922-23

The average rate paid common building labor in the United States, compiled from reports received from twenty important centers, is now about 50c. per hr., or 16 per cent above the rate prevailing in June, 1922.

Present costs as applied to unskilled common labor are now approximately 194 per cent above the 1913 average and 19 per cent below the peak of 1920.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of April 5; the next, on May 3.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	$3.44	$4.20	$4.50	$3.30	+$3.55	+$4.20	+$3.85	$4.10	$3.75
Structural rivets, 100 lb.	4.00	4.85	5.25	3.75	+4.25	5.15	4.75	4.50	6.00
Reinforcing bars, ¾ in. up, 100 lb.	3.34	4.10	3.15	3.22½	+3.45	3.85	3.40	4.10	3.50
Steel pipe, black, 2½ to 6 in. lap, discount	51%	52%	45%	59½%	55-5%	38%	38.2@50.2%	45%	32.76
Cast-iron pipe, 6 in. and over, ton	58.50	+58.00	57.00	+58.20	60.50	67.00	60.00	+60.00	60.00
Concreting Material:									
Cement without bags, bbl.	+2.80	3.25	2.25	2.20	2.39	2.85	2.71	2.90	2.68
Gravel, ¾ in., cu.yd.	2.25	1.90	2.25	2.25	1.75	1.90	2.15	1.25	1.50
Sand, cu.yd.	1.00	1.24	+1.90	2.25	1.00	1.00	1.50	1.25	1.25
Crushed stone, ¾ in., cu.yd.	1.75	2.00	2.50	2.25	2.25	3.50	2.15	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	65.00	40.00	53.00	60.00	45.75	42.75	39.00	+31.00	95.00
Lime, finishing, hydrated, ton	16.80@17.10	23.00	22.50	20.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	3.00@3.25	1.40	2.50	1.50	1.25	2.70	1.75	2.80	11.00
Common brick, delivered, 1,000	23.50	13.00	+13.10	11.00	17@19	12.00	15.00	13.00	16.50
Hollow building tile, 4x12x12, per block	Not used	.0893	.115	....	.0836	.065	....	.11	.115
Hollow partition tile 4x12x12, per block	.1314	.0893	.115	.0674	....	.065	.108	.11	....
Linseed oil, raw, 5 bbl. lots, gal.	+1.16	+1.28	+1.35	1.25	+1.34	+1.41	1.34	.86	1.16
Common Labor:									
Common labor, union, hour	.75	.35	.....	.....	.....	.50@.55	.56¼	....	.....
Common labor, non-union, hour	.....	.30	.30@.50	.72½	.35@.50	.35@.50	.50	.30@.70	.25

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b.

Labor—Concrete laborers' rate, 81½c.; building laborers, 75c.; minimum for pick and shovel men, 50c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.60 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in iron bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine casing. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 97.86). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½-in., $32.76; 6-in., $108.

Changes Since Last Week

Reinforcing bars firm at $2.50 per 100 lb., Pittsburgh, with quotations of $2.75, frequently made for prompt deliveries. Plates and shapes remain stronger and higher than bars; minimum price, $2.45, maximum $2.75@$2.85, owing to premiums demanded for spot shipments, due to pressure at the mills. Ship and tank plate consumers and steel fabricators taking bulk of tonnage. Steel structurals up 25c. in Denver, 15c. in San Francisco and 10c. in Minneapolis; bars advanced 12½c. in Denver and 10c. per 100 lb. in Minneapolis, following mill rise.

The Birmingham mill base on 6-in. Class B cast-iron pipe-advanced $2, to the present price of $49 per ton, effective Apr. 9. Atlanta warehouses quote rise of $3, Seattle, $2 and Chicago, $1 per ton, following mill advance.

Cement quoted at $2.80 per bbl., without bags, in New York, against $2.70@$2.80; sand now $1.90 per cu.yd. up from $1.87½ and common brick $13.10 per M., compared with $11.60, delivered to users in Dallas, Texas, one week ago.

Lumber prices show very little change, with the upward trend of the market apparently temporarily checked Douglas fir timbers (base) $31 in Seattle, against $30 per M. ft. b.m., last week; this represents the only change in lumber prices in nine cities reporting weekly to *Engineering News-Record*.

Seed scarcity causing gradual rise in linseed oil quotations. Raw oil up 2c. in Denver, 3c. in New York, Dallas and Atlanta and 5c. per gal. in Minneapolis.